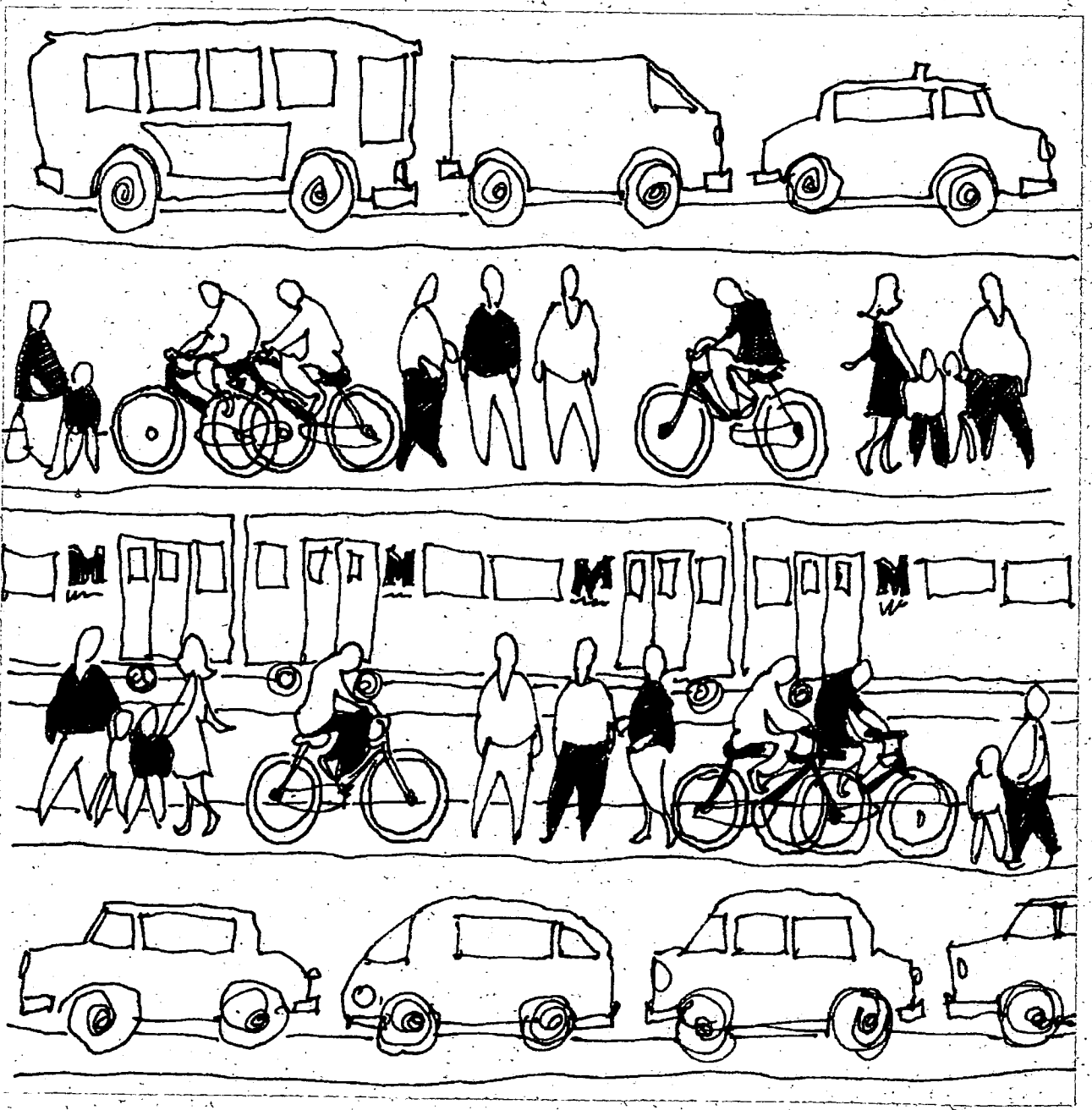
AUGUST 1999

TRANSPORTATION POLICY REPORT

STAFF DRAFT



THE MARYLAND-NATIONAL CAPITAL PARK & PLANNING COMMISSION
MONTGOMERY COUNTY PARK & PLANNING DEPARTMENT

Revised 9-3-99

Table 2-1: Facilities in the Recommended Network
(including facilities in 1998 CLRP as indicated with an asterisk)

Rail Transit

- Corridor Cities Transitway between Shady Grove Metro station and COMSAT
- * Georgetown Branch between Silver Spring Transit Center and Bethesda Metrorail station
- North Bethesda Transitway between Grosvenor Metro station and Montgomery Mall

Busways

- Georgia Ave Busway between Glenmont Metro station and Olney

HOV and Bus Lanes

- I-270 southbound between Clarksburg Rd (MD 121) and I-370
- I-270 between Clarksburg Rd (MD 121) and Frederick County Line
- I-495 between I-95 and American Legion Bridge

Roadways

- * Bordly Dr between Georgia Ave (MD 97) east to existing Bordly Dr: construct to 2 lanes
- * Briggs Chaney Rd between Castle Blvd and Prince George's County line: widen to 4 lanes
- * Brink/Wightman Rd, Ridge Rd (MD 27) to Goshen Rd: reconstruct-4 lanes
- * Chapman Ave between Bou Ave and Nicholson Lane: extend as 4 lanes
- Darnestown Rd (MD 28) between Riffleford Rd and Muddy Branch Rd: widen to 4 lanes
- * Darnestown Rd/Key West Ave (MD 28) between Muddy Branch Rd and Great Seneca Hwy(MD 119): widen to 6 lanes
- Fairland Rd between Columbia Pk (US 29) and Briggs Chaney Rd: widen to 4 lanes
- * Father Hurley Blvd. between Wisteria and Germantown Rd (MD 118) relocated: construct as 4 lanes
- * Ridge Rd between I-270 and Frederick Road (MD 355): widen to 6 lanes
- * Frederick Rd (MD 355) between Montgomery Village Ave (MD 124) and Middlebrook Rd: widen to 6 lanes
- * Frederick Rd (MD 355) between Ridge Rd (MD 27) and Stringtown Rd (MD 121): widen to 4 lanes
- Georgia Ave (MD 97) Brookeville Bypass: construct as 2 lanes
- * Germantown Rd Extended (MD 118) between Frederick Rd (MD 355) and Scenery Dr: widen to 6 lanes
- * Germantown Rd Extended (MD 118) between Scenery Dr and Midcounty Hwy/Watkins Mill Rd: construct as 6 lanes
- * Goshen Rd between Girard Street and Warfield Rd: widen to 4 lanes
- * Great Seneca Hwy (MD 119)between Middlebrook Rd and Quince Orchard Rd (MD 124): widen to 6 lanes
- Midcounty Highway between Montgomery Village Ave and Stringtown Rd (MD 121): extend as 4 lanes
- * Middlebrook Rd Extended between Frederick Rd (MD 355) and Midcounty Hwy: widen to 6 lanes
- * Middlebrook Rd between Great Seneca Hwy (MD 119) and I-270: widen to 6 lanes
- * Montrose Parkway between I-270 and Veirs Mill Road: construct as 4 lanes
- * Nebel Street Extended between Randolph Rd and Bou Ave: construct as 4 lanes
- New Road between I-370 and Layhill Rd: construct as 4 lanes
- New Road between Columbia Pk (US 29) and Baltimore Ave (US 1): construct as 4 lanes
- Newcut Rd between I-270 and Frederick Rd (MD 355): construct as 4 lanes

Table 2-1: Facilities in the Recommended Network (continued)

- Norbeck Rd Extended and MD 198 between Layhill Rd and Columbia Pk (US 29): widen to 4 lanes (includes portion currently in CLRP)
- ✳ Quince Orchard Rd (MD 124) between Darnestown Rd (MD 28) and Longdraft Rd: widen to 6 lanes
- ✳ Randolph Rd between Fairland Rd and Old Columbia Pike: widen to 5 lanes
- ✳ Shady Grove Rd between Briardale Rd and Muncaster Mill Rd (MD 115): widen to 6 lanes
- ✳ Snouffer School Rd between Goshen Rd and Centerway Rd: widen to 4 lanes
- ✳ Stringtown Rd Relocated (MD 121) between Frederick Rd (MD 355) and Midcounty Hwy: widen to 4 lanes
- ✳ Stringtown Rd Relocated (MD 121) between I-270 and Frederick Rd (MD 355): construct as 4 lanes
- ✳ Valley Park Dr between east of Ridge Rd (MD 27) and existing Valley Park Dr: construct as 2 lanes
- ✳ Watkins Mill Rd between Clopper Rd (MD 117) and Frederick Ave (MD 355): construct as 4 lanes
- ✳ Woodfield Rd between Warfield Rd and Airpark Rd: widen to 6 lanes
- ✳ Woodfield Rd Extended (MD 124) between Main St (MD 108) and Ridge Rd (MD 27): construct as 2 lanes

Interchanges

- I-270 @ Newcut Rd Extended
- I-270 @ Watkins Mill Rd Extended
- ✳ I-270 West Spur @ Fernwood Rd/Democracy Blvd; reconstruct
- ✳ I-270 East Spur @ Old Georgetown Rd (MD 187) and Rockledge Dr connector
- ✳ Georgia Ave (MD 97) @ Randolph Rd
- ✳ Clopper Rd (MD 117) @ Quince Orchard Blvd (MD 124)
- ✳ Columbia Pk (US 29) @ Briggs Chaney Road
- Columbia Pk (US 29) @ Fairland Road
- ✳ Columbia Pk (US 29) @ Randolph Road/Cherry Hill Road
- ✳ Columbia Pk (US 29) @ Spencerville Rd (MD 198)/Blackburn Road: construct
- Columbia Pk (US 29) @Tech Road
- Frederick Rd (MD 355) @ Gude Dr
- Frederick Rd (MD 355) @ Montgomery Village Ave
- Frederick Rd (MD 355) @ Shady Grove Road
- Rockville Pk (MD 355) @ Montrose Road/CSX
- Rockville Pk (MD 355) @ Nicholson Lane
- Great Seneca Hwy (MD 119) @ Key West Highway (MD 28)
- Great Seneca Hwy (MD 119) @Sam Eig Hwy

Intersections

- Randolph Rd @ Connecticut Ave
- Randolph Rd @ New Hampshire Blvd
- Randolph Rd @ Veirs Mill Rd

Other

- ✳ Burtonsville Park-and-Ride
- ✳ Damascus Park-n-Ride
- ✳ Four Corners Transit Center
- ✳ Germantown Transit Center
- ✳ Lake Forest Transit Center
- MARC North Bethesda Station
- ✳ Olney Transit Center
- ✳ Shady Grove West Transit Center
- ✳ Silver Spring Transit Center
- ✳ White Oak Transit Center

Table 4-1: Comparison of 2020 Alternative Networks

revised 9/1/1999

Measures of Effectiveness (MOEs)	1998 Base	2020 Base	2020 Comb A	2020 Comb B	2020 Comb C	2020 Comb D	2020 Rec Plan
Auto Mobility							
Total Lane-Miles	2,472	2,606	2,619	2,796	2,730	2,792	2,791
Vehicle-Miles Traveled (VMT, thousands)	1,446	1,814	1,791	1,890	1,848	1,910	1,867
Vehicle-Hours Traveled (VHT, thousands)	55	102	93	93	94	96	89
Average Speed (Miles/Hour)	26.1	17.7	19.2	20.4	19.6	19.8	21
Percent of Lane-Miles Congested	9.7%	20.6%	18.9%	18.7%	19.4%	19.8%	17.0%
Transit Mobility							
Number of Transit Boardings (thousands)	66.5	100.3	114.7	133.5	138.9	149.8	142.8
Bus	30.6	58.4	49.4	78.3	42	58.2	71.6
Rail	35.9	41.9	65.3	55.2	96.9	91.6	71.2
Transit Accessibility							
Countywide Accessibility Index to Households (thousands)	98	104	116	129	138	146	137
Countywide Accessibility Index to Jobs (thousands)	182	194	217	240	267	281	254
Activity Center Accessibility Index to Households (thousands)	155	162	183	204	250	261	229
Percent of Jobs within 1/2 mile of Rail Stations	40%	37%	50%	50%	61%	61%	56%
Percent of Households within 1/2 mile of Rail Stations	13%	15%	20%	20%	26%	26%	20%
Average Transit Travel Time (minutes)	55.9	60.4	53.8	48.2	47.6	45.9	46.8
Auto Accessibility							
Countywide Accessibility Index to Households (thousands)	546	647	667	722	653	726	748
Countywide Accessibility Index to Jobs (thousands)	423	1,134	1,174	1,189	1,107	1,235	1,286
Activity Center Accessibility Index to Households (thousands)	195	658	672	741	669	740	771
Average Auto Travel Time (minutes)	26	35.2	33.8	32.6	33.9	32.6	31.1
Mode Share							
Transit	17.5%	18.6%	19.4%	21.3%	21.5%	21.9%	21.6%
Single-Occupancy Vehicle (SOV)	70.7%	67.9%	67.2%	65.7%	65.4%	65.2%	65.4%
High-Occupancy Vehicle (HOV)	7.8%	7.6%	7.5%	7.5%	7.4%	7.4%	7.5%
Walk/Bike	4.0%	5.8%	5.9%	5.5%	5.6%	5.4%	5.5%

Shaded area indicates 9/1/1999 revision

Table 4-5: Capital Cost Estimates

revised 9/1/1999

Category	In 1998 CLRP	Included in Combo A	Included in Combo B	Included in Combo C	Included in Combo D	Included in Rec Plan
Rail transit	$235	$574	$235	$2,154	$2,154	$754
Busways	$0	$0	$251	$56	$56	$56
HOV lanes	$0	$0	$645	$0	$645	$645
Roadway construction/widenin	$508	$532	$1,087	$727	$1,087	$1,087
Intersections/interchanges	$89	$186	$356	$356	$356	$356
Other	$14	$33	$33	$33	$33	$33
TOTAL	$846	$1,325	$2,607	$3,326	$4,331	$2,931

Notes:

1. Sources of capital cost estimates include MWCOG, MSHA, MCDPWT, and M-NCPPC.
2. The "1998 CLRP" cost estimate has been developed for comparative purposes and therefore varies from MWCOG estimates.

Table 4-6: Detailed Capital Cost Estimates*

Revised 9/1/1999

Category, Project	Capital Cost ($M, 1999)	In 1998 CLRP	Included in Combo A	Included in Combo B	Included in Combo C	Included in Combo D	Included in Rec Plan
Rail Transit							
Georgetown Branch Trolley, Bethesda to Silver Spring	$235	$235	$235	$235	$235	$235	$235
Corridor Cities Transitway, Shady Grove to Germantown	$195	$0	$195	$0	$195	$195	$195
Corridor Cities Transitway, Germantown to Clarksburg	$144	$0	$144	$0	$144	$144	$144
US 29 Light Rail, Silver Spring to Burtonsville	$560	$0	$0	$0	$560	$560	$0
North Bethesda Transitway, Grosvenor to Montgomery Mall	$180	$0	$0	$0	$180	$180	$180
Outer Purple Line - Grosvenor to White Oak	$370	$0	$0	$0	$370	$370	$0
Inner Purple Line - Silver Spring to College Park	$470	$0	$0	$0	$470	$470	$0
Busway							
Corridor Cities Transitway, Shady Grove to Clarksburg	$195	$0	$0	$195	$0	$0	$0
Georgia Avenue Busway, Glenmont to Olney	$56	$0	$0	$56	$56	$56	$56
HOV Lanes							
I-270, MD 121 to Frederick County line	$20	$0	$0	$20	$0	$20	$20
I-270, MD 121 to I-370 Southbound Only	$75	$0	$0	$75	$0	$75	$75
I-495, American Legion Bridge to I-95	$550	$0	$0	$550	$0	$550	$550
Roadway Segments							
Road, I-370 to Layhill, construct as 4 lanes	$360	$0	$0	$360	$0	$360	$360
Road, US 29 to Prince George's County, construct as 4 lanes	$60	$0	$0	$60	$60	$60	$60
MD 28, Great Seneca to Riffle Ford, widen to 4/6 lanes	$27	$27	$27	$27	$27	$27	$27
MD 97 Brookeville Bypass, construct as 2 lanes	$13	$0	$13	$13	$13	$13	$13
MD 118 Ext., MD 355 to Midcounty, construct as 6 lanes	$4	$4	$4	$4	$4	$4	$4
MD 119, Middlebrook to MD 124, widen to 6 lanes	$18	$18	$18	$18	$18	$18	$18
MD 121 Relocated, I-270 to MD 355, construct as 4 lanes	$10	$0	$0	$10	$10	$10	$10
MD 121 Relocated, MD 355 to Midcounty, construct as 4 lanes	$25	$0	$0	$25	$25	$25	$25
MD 124, Airpark to Warfield, widen to 6 lanes	$6	$0	$6	$6	$6	$6	$6
MD 124, MD 28 to Longdraft, widen to 6 lanes	$4	$4	$4	$4	$4	$4	$4
MD 124 (Woodfield Rd ext), MD 108 to MD 27, construct as 2 lanes	$5	$5	$5	$5	$5	$5	$5
MD 355, Middlebrook to MD 27, widen to 6 lanes	$26	$26	$26	$26	$26	$26	$26
MD 355, MD 27 to MD 121, widen to 4 lanes	$20	$0	$0	$20	$20	$20	$20
Briggs Chaney, Castle to PG Co line, widen to 4 lanes	$9	$9	$9	$9	$9	$9	$9
Briggs Chaney, Realign at MD 650	$4	$4	$4	$4	$4	$4	$4
Brink/Wightman, MD 27 to Goshen, widen to 4 lanes	$44	$44	$44	$44	$44	$44	$44
Chapman Avenue, Bou to Executive, construct as 4 lanes	$65	$65	$65	$65	$65	$65	$65
Fairland Road, US 29 to Briggs Chaney, widen to 4 lanes	$6	$6	$6	$6	$6	$6	$6
Father Hurley Boulevard, I-270 to MD 355, widen to 6 lanes	$3	$3	$3	$3	$3	$3	$3
Goshen Road, Girard to Warfield, widen to 4 lanes	$56	$56	$56	$56	$56	$56	$56
Midcounty Highway, Mont. Vill. to MD 121, construct as 4 lanes	$80	$0	$0	$80	$80	$80	$80
Middlebrook Road, MD 355 to Midcounty, widen to 6 lanes	$2	$2	$2	$2	$2	$2	$2
Montrose Parkway, I-270 to MD 355, construct as 4 lanes	$63	$63	$63	$63	$63	$63	$63
Montrose Parkway, Parklawn to MD 586, construct as 4 lanes	$15	$15	$15	$15	$15	$15	$15
Nebel Street Ext, Randolph to Bou, construct as 4 lanes	$10	$10	$10	$10	$10	$10	$10
Newcut Road, I-270 to MD 355, construct as 4 lanes	$5	$0	$5	$5	$5	$5	$5
Norbeck/MD 198, Layhill to US 29, widen to 4 lanes	$105	$105	$105	$105	$105	$105	$105
Shady Grove Road, MD 115 to Briardale, widen to 6 lanes	$4	$4	$4	$4	$4	$4	$4
Snouffer School Road, Goshen to Centerway, widen to 4 lanes	$21	$21	$21	$21	$21	$21	$21
Watkins Mill Road, MD 117 to MD 355, construct as 4 lanes	$17	$17	$17	$17	$17	$17	$17
Interchanges							
I-270 @ Newcut Road	$15	$0	$0	$15	$15	$15	$15
I-270 @ Watkins Mill Road	$25	$0	$0	$25	$25	$25	$25
I-270 Spur @ MD 187/Rockledge Connector	$14	$14	$14	$14	$14	$14	$14
I-270 Spur @ Democracy Boulevard/Fernwood Road	$14	$14	$14	$14	$14	$14	$14
US 29 @ Briggs Chaney	$24	$24	$24	$24	$24	$24	$24
US 29 @ Fairland or Musgrove Road	$19	$0	$19	$19	$19	$19	$19
US 29 @ MD 198/Blackburn	$37	$37	$37	$37	$37	$37	$37
US 29 @ Tech Road	$17	$0	$17	$17	$17	$17	$17
MD 117 @ MD 124	$20	$0	$0	$20	$20	$20	$20
MD 119 @ MD 28	$15	$0	$0	$15	$15	$15	$15
MD 119 @ Sam Eig	$15	$0	$0	$15	$15	$15	$15
MD 355 @ Gude	$20	$0	$0	$20	$20	$20	$20
MD 355 @ Montgomery Village Avenue	$20	$0	$0	$20	$20	$20	$20
MD 355 @ Montrose Road/CSX	$30	$0	$30	$30	$30	$30	$30
MD 355 @ Nicholson	$20	$0	$0	$20	$20	$20	$20
MD 355 @ Shady Grove	$20	$0	$0	$20	$20	$20	$20
MD 97 @ Randolph Road	$25	$0	$25	$25	$25	$25	$25
Intersections							
Randolph @ Connecticut	$2	$0	$2	$2	$2	$2	$2
Randolph @ New Hampshire	$2	$0	$2	$2	$2	$2	$2
Randolph @ Veirs Mill	$2	$0	$2	$2	$2	$2	$2
Other							
Four Corners Transit Center	$3	$3	$3	$3	$3	$3	$3
MARC North Bethesda Station	$3	$3	$3	$3	$3	$3	$3
Olney Transit Center	$1	$1	$1	$1	$1	$1	$1
Shady Grove West Transit Center	$4	$4	$4	$4	$4	$4	$4
Silver Spring Transit Center	$19	$0	$19	$19	$19	$19	$19
Other Transit Centers	$3	$3	$3	$3	$3	$3	$3
TOTALS		**$846**	**$1,325**	**$2,607**	**$3,326**	**$4,331**	**$2,931**

*Currently Funded Roadway Projects Not Shown

Shaded areas indicate revised estimates or additional projects

Table 4-7: Cost Efficiency Index

revised 9/1/1999

Measures of Effectiveness (MOEs)	Change From Base Divided by Capital Cost					Efficiency Index[1]				
	2020 Comb A	2020 Comb B	2020 Comb C	2020 Comb D	2020 Rec Plan	2020 Comb A	2020 Comb B	2020 Comb C	2020 Comb D	2020 Rec Plan
Capital Cost of Network (Billions)	$1.325	$2.607	$3.326	$4.331	$2.931					
Auto Mobility										
Average Speed (Miles/Hour)	1.13	1.04	0.57	0.48	1.13	100	91	50	43	99
Percent of Lane Miles Congested	1.28	0.73	0.36	0.18	1.23	100	57	28	14	96
Vehicle-Hours Traveled (VHT, thousands)	6.79	3.45	2.41	1.39	4.44	100	51	35	20	65
Transit Mobility										
Average Transit Travel Time (minutes)	4.98	4.68	3.85	3.35	4.64	100	94	77	67	93
Transit Accessibility										
Countywide Accessibility Index to Households (thousands)	9.06	9.59	10.22	9.70	11.26	80	85	91	86	100
Countywide Accessibility Index to Jobs (thousands)	17.36	17.64	21.95	17.09	20.47	79	80	100	78	93
Activity Center Accessibility Index to Households (thousands)	15.85	16.11	26.46	22.86	22.86	60	61	100	86	86
Percent of Jobs within 1/2 mile of Rail Stations	9.81	4.99	7.22	5.54	6.48	100	51	74	56	66
Percent of Households within 1/2 mile of Rail Stations	3.77	1.92	3.31	2.54	1.71	100	51	88	67	45
Auto Accessibility										
Countywide Accessibility Index to Households (thousands)	15.09	28.77	1.80	18.24	34.46	44	83	5	53	100
Countywide Accessibility Index to Jobs (thousands)	30.19	21.10	-8.12	23.32	34.46	88	61	-24	68	100
Activity Center Accessibility Index to Households (thousands)	10.57	31.84	3.31	18.93	38.55	27	83	9	49	100
Average Auto Travel Time (minutes)	1.06	1.00	0.39	0.60	1.40	76	71	28	43	100
Optimize Investment/Mode Share										
Transit Mode Share (percent of total)	0.60	1.04	0.87	0.76	1.02	58	100	84	74	99

[1]The best change from base/cost was set at 100 with all others rated relative to 100.

M-NCPPC

MONTGOMERY COUNTY DEPARTMENT OF PARK AND PLANNING

THE MARYLAND-NATIONAL CAPITAL
PARK AND PLANNING COMMISSION

8787 Georgia Avenue
Silver Spring, Maryland 20910-3760

August 23, 1999

Dear Reader:

The Transportation Policy Report represents a significant effort to review future comprehensive transportation networks for Montgomery County. The Planning Board wanted this study to make sense of four major investment studies being undertaken by the Maryland State Department of Transportation as well as ideas embodied in adopted Master Plans. The Planning Board also wanted to make sure that the recommendations it will be making to the County Council on the State Consolidated Transportation Program and changes to the federally mandated Constrained (constrained by fiscal resources) Long Range Plan for the Washington region, this fall, were in the context of a coherent vision of the future. The Transportation Policy Report responds to that need. Staff has reviewed five alternative networks and recommended one which they believe should be pursued as well as which projects should move toward construction soonest.

This report is an attempt to help assure the future accessibility of major activity centers within the County, a critical component of quality of life for all residents. The study measures the effectiveness of alternative networks on a number of criteria. Some measures relate to the mobility added by transit service, others deal with roadway measures. Readers have the opportunity to judge the alternatives by the criteria most important to them.

The measures of effectiveness were partially derived from predicting the transportation behavior of future residents and workers. This is done by modeling existing behavior and applying that behavior to a future with additional housing, job and transportation facilities. The effect of changes in the distribution of regional growth is accounted for in the model as well as growth within the County. The report did not assume any changes to government policies that either change the forecasted distribution of land use or the current economics involved in people choosing transit or cars. Policies which could affect decisions to locate at a particular place and travel behavior are identified in the report for possible future evaluation.

The one clear conclusion from this study is the significance of the financial resources that it will take in order to avoid intolerable reductions in mobility due to increased congestion. The staff recommended network would require approximately three times the existing fiscal effort currently projected for transportation operation, maintenance and capital facilities over the next 20 years. This will be a challenge that will need to be addressed if we are to maintain sufficient mobility for a healthy community.

On behalf of the Planning Board, I encourage each of you to read this report and to consider its findings and recommendations. An Open House will be held at 7:30 PM on Tuesday, September 7 in the auditorium at 8787 Georgia Avenue in Silver Spring, where there will be an opportunity to discuss the report with staff. The Planning Board will receive public comment at its regular meeting on Thursday, September 9 and written testimony is welcome anytime. On September 16 and, if necessary, on September 23, the Planning Board will deliberate on the comments received and will direct the staff to make changes to the final report that will be delivered to the County Council.

Thank you for your consideration of this report and for your participation in the review of its findings and recommendations.

Sincerely,

William H. Hussmann
Chairman

WHH:JZ:kcw

Transportation Policy Report

Staff Draft

Revised
September 7, 1999

PREPARED BY
THE MARYLAND-NATIONAL CAPITAL PARK AND PLANNING COMMISSION

MONTGOMERY COUNTY PARK AND PLANNING DEPARTMENT
8787 GEORGIA AVENUE
SILVER SPRING, MD 20910

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Chapter I: Study Purpose and County Travel Needs

This chapter has three main themes. The first details the study purpose and scope, and the process staff has been pursuing to involve the community in the study. The next provides background on the current travel patterns and future growth that will shape the transportation system and be shaped by it, as well as unmet travel needs emerging from this preliminary analysis. The final theme presents the staff review of the Governors Transportation Solutions Group report, which contains recommendations on polices and actions directly relevant to those addressed in our study. The sections included are:

Purpose and scope of work

- Public participation process
- Factors affecting travel demand
- Growth trends
- Commuting patterns
- Analysis of unmet future needs
- Staff review of the Transportation Solutions Group Report of June 1999

1. Purpose and Scope of Work

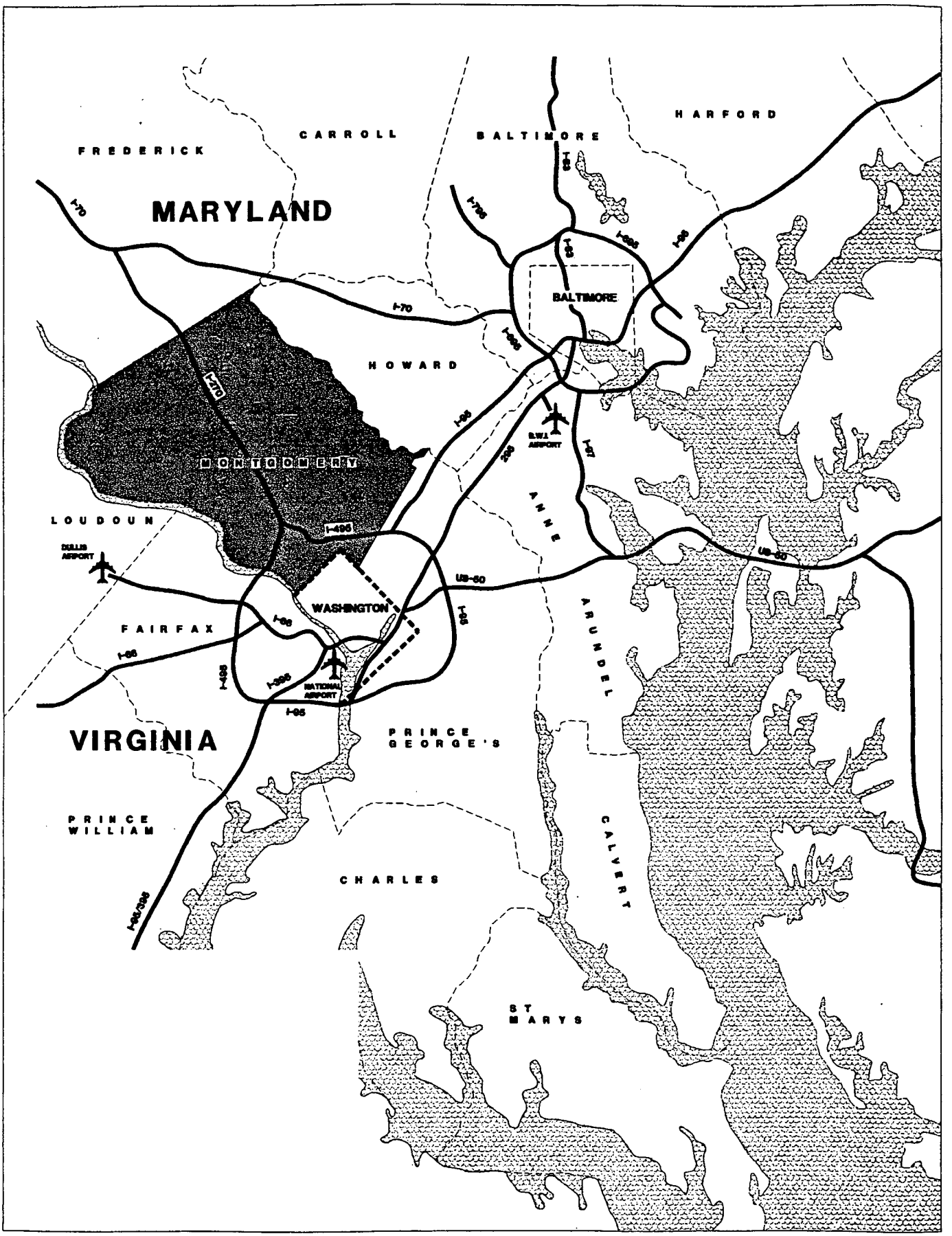
The purpose of the Transportation Policy Report (TPR) study is to analzye Montgomery County's future transportation needs and develop recommended transportation networks and policies to meet those needs. The primary focus is on the future network of transitways -- the major transit-only separate alignments -- but large roadway projects are included as well because they are an essential part of meeting future needs. The TPR also prioritizes future upbuilt portions of the network to identify projects that should be funded in the upcoming five-year cycle.

As shown in **Figure 1-1**, Montgomery County is located in the Washington Metropolitan Region. Montgomery County is bounded by the District of Columbia to the south, Prince George's County to the east, Howard and Frederick Counties to the north, and Fairfax and Loudoun Counties to the west, across the Potomac River in Virginia.

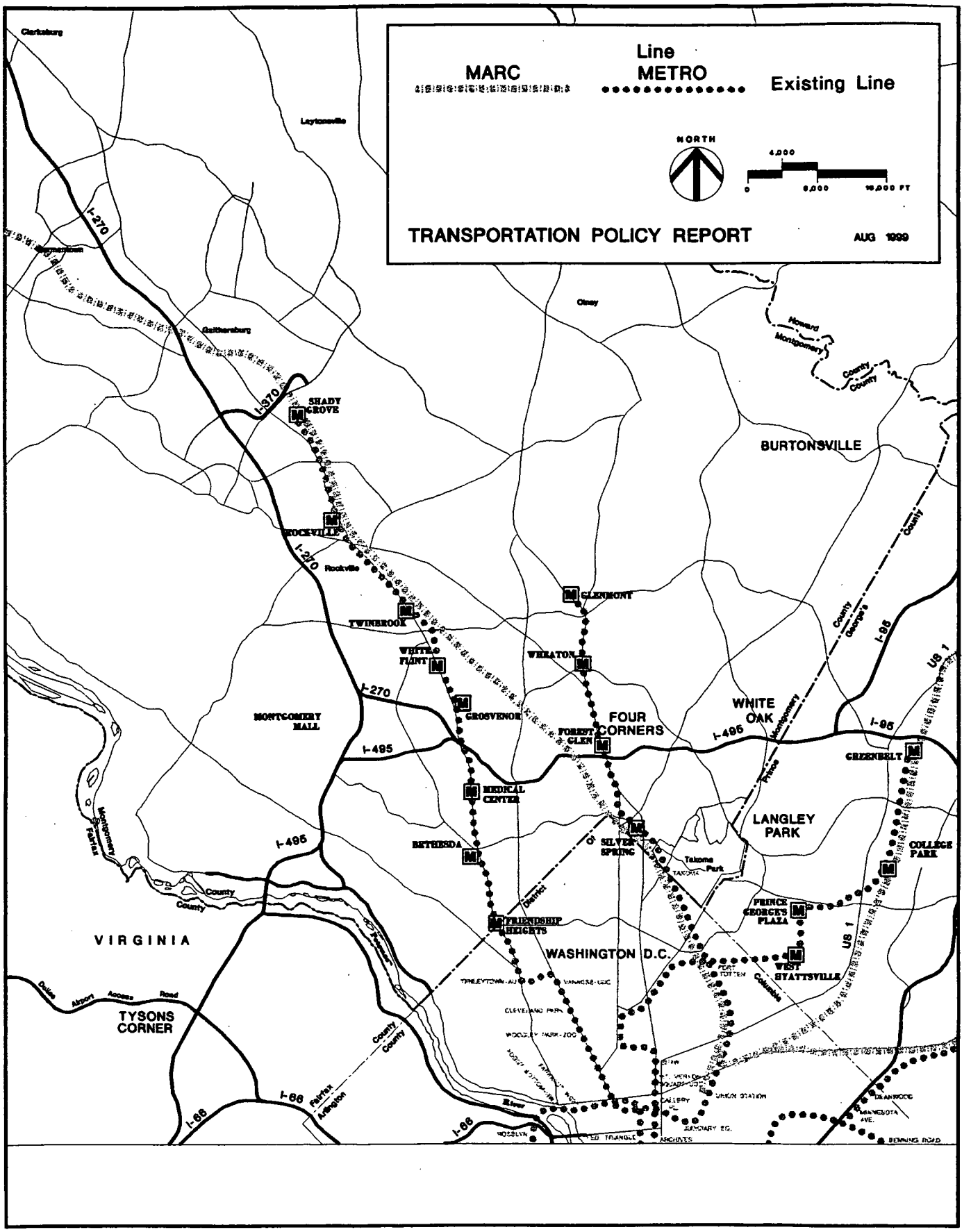
The County transportation networks are framed by several key connections. **Figure 1-2** shows the interstates and major highways, and the Metrorail Red Line and MARC commuter rail line which serve Montgomery County today.

REGIONAL LOCATION MAP

Figure 1-1



1999 MAJOR TRANSPORTATION SYSTEMS Figure 1-2



At the time the study began, in mid-1997, six key transportation studies were underway in Montgomery County. These major projects, all of which are on the County's master plans and provide important planned travel capacity, are included in this study because they are on the Maryland State roadway system or, in the case of transitways, expected to ultimately be constructed by the state. Other than the Georgia Avenue Busway, they were all in some phase of project planning when the study began. The projects include:

- I-270 Major Investment Study (MIS): considering roadway expansion and transit alternatives along and near I-270 from Shady Grove to the City of Frederick.
- Georgetown Branch Trolley/Trail: Draft Environmental Impact Statement (DEIS) completed on a bus or rail connection between Bethesda CBD and Silver Spring CBD, including a multi-use trail.
- Capital Beltway MIS: considering roadway and transit alternatives for the Capital Beltway in Maryland and coordination with a similar project in Virginia
- US 29 Busway: evaluating the feasibility of a busway connecting the Silver Spring CBD and Burtonsville, with emphasis on the section from Four Corners to Burtonsville.
- Georgia Avenue Busway: evaluating the feasibility of a median busway from the Glenmont Metrorail station to Olney.
- Intercounty Connector: MIS/DEIS evaluating roadway and transit alternatives from I-270 to I-95 in Prince Georges' County.

In the two years that this study has been underway, significant changes have taken place in the status of these projects. An essential change was the position of the Montgomery County Council that a full ICC-type roadway between I-270 and I-95 is not acceptable. In addition, the Council selected a set of transportation improvements that has formed the basis for one of the alternative networks tested in this study.

Construction funding is currently anticipated for only one of these six projects, (Georgetown Branch Trolley/Trail) in the 1998 Constrained Long Range Plan (CLRP) of the Metropolitan Washington Council of Governments (COG.) This means that, for the twenty-year period of the CLRP, no funds were identified as being available for any of the other five projects. Also within Montgomery County, there was no process underway to comprehensively decide which projects should be funded, if additional resources were available, or to prioritize future funds of any type. This Report is intended to fill that gap.

One of the limitations of the current NEPA environmental review process is that the "no-action" or base condition for a major investment study must only include projects which are programmed in the regional CLRP. Therefore, each MIS is evaluated in a vacuum without the opportunity to consider the synergy which multiple projects might generate. The work on this Report began in order to evaluate the alternative alignments of these six studies as components of networks to determine what combination would best serve the future transportation needs of Montgomery County. Within the scope of the study, it was appropriate to identify new projects that would link these planned projects or other alignments meeting identified needs. The work scope included a detailed review of Year

2020 forecasts. At the request of interested citizens, staff also expanded the scope to incorporate a review of the Year 2050, with focus on how land use can be used to reduce future auto travel.

Staff specifically evaluated alternative networks which combined the projects under consideration by the six studies in relation to the Round 6.1 Cooperative Forecast for Year 2020. This forecast represents the households and employment for each jurisdiction in the Washington Metropolitan Region. Networks were also developed for evaluation in relation to the land use patterns which would exist if all of the County's master plans were developed through Year 2050. In addition, three scenarios were also developed for Year 2050 to evaluate how well the networks would meet the need of future development beyond Year 2020. The Findings and Recommendations are set forth in **Chapter II.** Details of this effort are found in **Chapter III**, Study Process, and results are summarized in **Chapter IV**, Evaluation.

2. Public Participation Process

One of the objectives of this study was to make sure that as many residents, employees and business owners as possible were aware of the study and its process. To this end, staff conducted a variety of activities that informed them and solicited their opinions. Part of this effort included a Project Advisory Team made up of interested citizens, and a Technical Advisory Team of staff from other agencies. Board sessions about the report were also open, and time for public comment was available. This section describes these activities, which will continue during the review period for this report.

- **Project Advisory Groups**

  Throughout the development of this Report, staff has been assisted by a Project Advisory Team (PAT). The members, listed in **Table 1-1**, represent civic and citizens associations, business interests, and interest groups related to transportation. The PAT has met monthly to review and comment on information prepared by staff regarding the analyses leading up to the Recommended Network. The members provided helpful guidance throughout the process of developing this Report.

  In addition to the Project Advisory Team, staff has been assisted by a Technical Work Group (TWG). The members of the TWG are staff of County, regional and state agencies. The agencies represented are also listed on **Table 1-1.**

Table 1-1: Members of the Project Advisory Process

Project Advisory Team
Mahlon G. Anderson, American Automobile Association
James Clarke, Sierra Club
Tim Dugan, Esq., Montgomery County Chamber of Commerce
David Eskenazi, Greater Olney Civic Association
Elmer Hulen, West Montgomery County Citizens Association
Richard Kauffunger, Layhill Alliance
Pamela Lindstrom, Washington Regional Network and Citizens Planning Association
John Robinson, Allied Civic Group
Stuart Rochester, Fairland Master Plan Citizens Advisory Committee
Harry Sanders, Action Committee for Transit
Ira Shesser, Greater Bethesda-Chevy Chase Coalition
Richard Strombotne, Clarksburg Civic Association
Scott Wallace, Esq., Montgomery County Chamber of Commerce
Dan Wilhelm, Greater Colesville Civic Association and Montgomery Civic Federation
Technical Work Group
Division of Transit Services, DPWT
MC Department of Economic Development
MC Department of Public Works and Transportation
Office of the County Executive/Planning Implementation
Metropolitan Washington Council of Governments
Office of Systems Planning & Evaluation, Maryland Department of Transportation
Maryland Mass Transit Administration

- **Transportation Policy Report Review**

  A newsletter format was used to summarize information related to the study. Two issues of *TPR Review* were prepared in October and November 1998 and distributed by mail and at public meetings and presentations. These newsletters provided an introduction to the TPR and to the issues and concepts to be addressed.

- **Open Houses**

  Open Houses provided an essential opportunity for two-way flow of information during the process. A pair of Open Houses was held in December 1998. One was held in Germantown at the Up-County Government Services Center and the other in Silver Spring at the Montgomery Regional Office Building. Approximately 50 people participated at each event. The purpose of these Open Houses was to introduce the public to the intent and process of the TPR and to the changes between the Years 1990 and 2020 in regard to land use and transportation.

  In May 1999, approximately 75 people participated in an additional Open House in Silver Spring. The purpose was to describe the initial analytical work leading up to the development of the four Mode-Specific Networks proposed for testing.

An Open House will be held regarding this Report on Tuesday, September 7, 1999, in the Auditorium of the Montgomery Regional Office Building, 8787 Georgia Avenue in Silver Spring. This Open House will focus on the study findings and recommendations.

- **Planning Board Progress Reports**

  Following each of the Open Houses, staff presented a Progress Report to the Montgomery County Planning Board during their normal Thursday public sessions. These presentation enabled the Planning Board and the public to be brought up-to-date on the work completed and the next steps in the process. Public comments were accepted by the Board at each of these meetings.

- **Presentations to Civic and Business Groups**

  Beginning in late 1998, staff began a significant effort to inform the public about the TPR. A wide variety of business and civic groups requested and were presented information on the report, at a time and place of their choosing.

3. Factors Affecting Transportation Demand

As Montgomery County has developed over the last several decades, commuting patterns have shifted in response to the changing land use distribution and the transportation facilities which have been provided. The District of Columbia has become less dominant as an employment center; an increasing percentage of Montgomery County's employed residents work within the County. Population and jobs have shifted out of the District and growth, particularly households, has spread further from the Metrorail-served areas of Montgomery County and into adjacent counties. The improvements to I-270 have increased the accessibility of both households and jobs in that corridor.

- **Factors Influencing Travel**

  As part of national trends, there have been, in Montgomery County over the past 20 years, significant changes in the factors affecting travel on the transportation networks. These include:

  - a significant increase in dual-income families
  - increases in the percentage of households with a single adult
  - retail outlets have increased in size in response to the increasing variety of products; this change has reduced the number of outlets and increased the distance to reach them
  - gasoline has continued to decrease in cost in relation to the consumer price index
  - the average number of automobiles per household continues to increase
  - people of driving age continues to increase as a percentage of population

The transportation analysis in this Report incorporates these changes.

- **Transportation, Land Use, and Human Behavior**

  No one travels in the peak hour to delight in the experience. People travel to get to and from places they want to go. Urban form and character result from the interaction of transportation, land use, and human behavior. This Report generally focuses on transportation facilities and services, but recognizes the importance of the other two. The discussion on land uses in Year 2050 in **Chapter IV** points out the interconnections of land use with future travel demands.

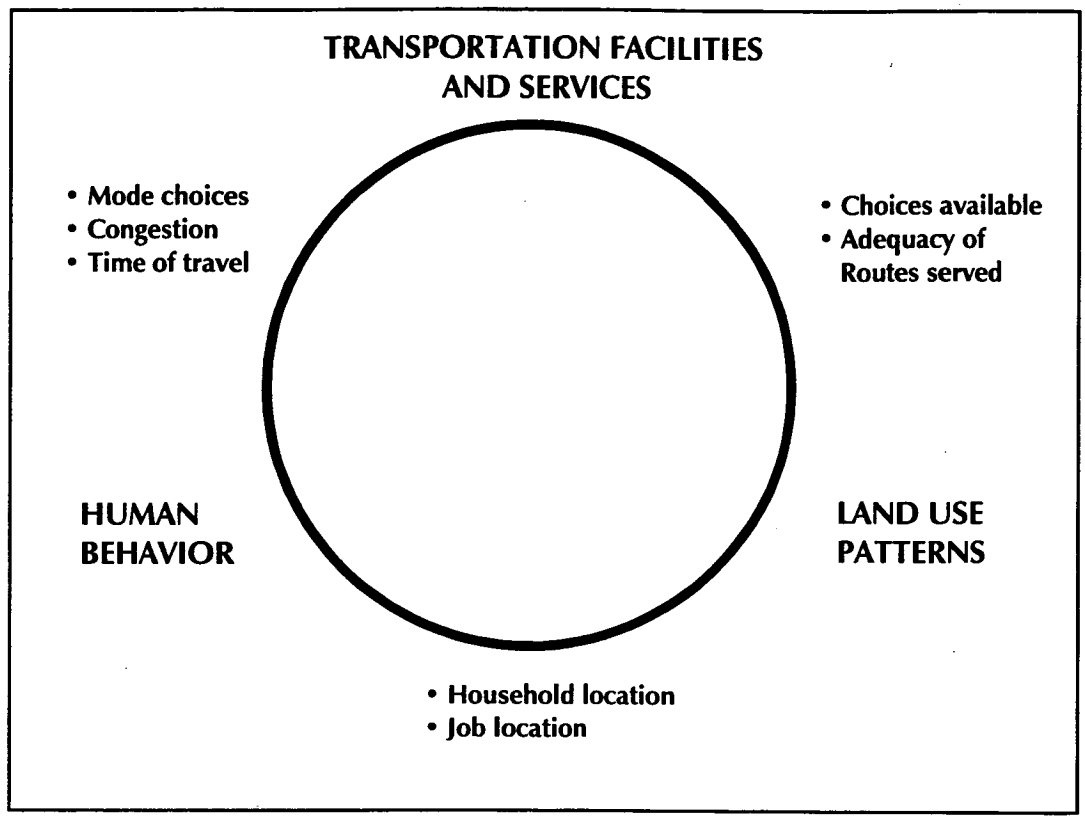
  Transportation facilities and services are planned and implemented to serve the existing, planned and evolving land use pattern. The use of these facilities and services is based on the land use pattern and the behavioral choices people make regarding travel. When to travel, where to travel and what mode to use are all choices each of us makes, consciously or unconsciously, every day. The aggregation of these choices related to existing transportation facilities and services may result in congestion and unanticipated delays. The transportation facilities and services may limit our choices and the existence of congestion and delays may affect when and where we travel. Congestion and limitations of transportation choices may also make a difference in housing and employment choices. Each of the three elements also changes over time in relation to the others and to outside forces. **Figure 1-3** is a diagram of the three elements showing some of the interrelationships.

  Each of the three elements are closely interrelated to the other two; a change in one causes changes in the other two. Over time each changes at differing and varying rates. It is important to develop policies and projects to maintain a balance among them. A change in the pace and direction in one element requires changes in the other two to maintain a desired balance.

- **Transit Supportive Land Use Policies and Regulations**

  There is no 'silver bullet' – no single action to 'solve the problem.' In order to achieve a desirable future, Montgomery County and the Washington Region need to develop a dynamic strategy which addresses all three elements -- transportation, land use, and human behavior -- and their inter-relationships over time.

Figure 1-3: Determinants of Congestion



Montgomery County is doing well in regard to transit supportive land use policies and regulations, but we can (and must) do better if we are to maintain our accessibility to mixed-use centers. There are ways to strengthen the policies and regulations we do use and there are new, at least for Montgomery County, actions to consider. Several of these are discussed in **Chapter II.**

Land use changes evolve over time, based on market and economic conditions, demographic make up, public policies, and planning decisions. The current patterns have been years in the making, and efforts to change current patterns to become more transit-oriented or reflect other policies will similarly take years to be effective.

4. Growth Trends

One of the key factors regarding transportation demand is the growth in jobs and households and the pattern and location of that growth. This Section of the Report describes the extent and character of growth in Montgomery County in the past and the projections for the future.

- **Comparative Rates and Amounts of Growth**

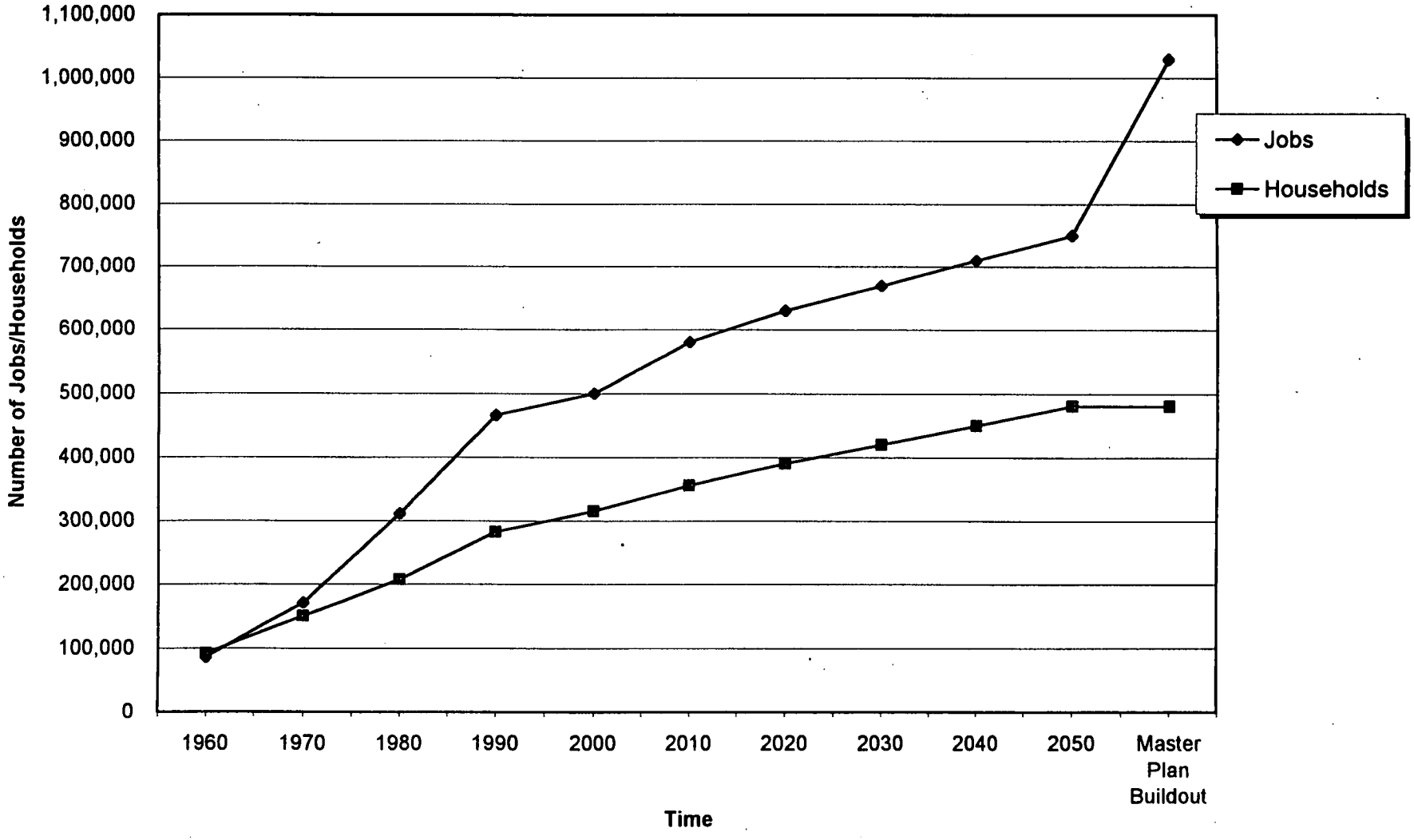
  Figure 1-4 shows job and household growth for Montgomery County from 1960 through Year 2050 and for Master Plan Buildout. The chart indicates that the rate of growth for both households and jobs has decreased since 1990 relative to the preceding two decades. It also shows the remaining amount of employment growth potential beyond the number included in the Year 2050 scenarios to the buildout of the current area master plans. The buildout of the master plans represents the approved ultimate development for Montgomery County.

  As the maximum residential density or employment capacity is rarely reached, the Research Division has computed the anticipated development for each zone based on historical trends. This upper limit is termed the holding capacity. The holding capacity for Montgomery County at master plan buildout results in approximately one million jobs. This is significantly more than the 750,000 jobs in the Year 2050 Scenarios. In order to make the three long-term land-use patterns comparable, the Master Plan Scenario was reduced to a total of 750,000 jobs.

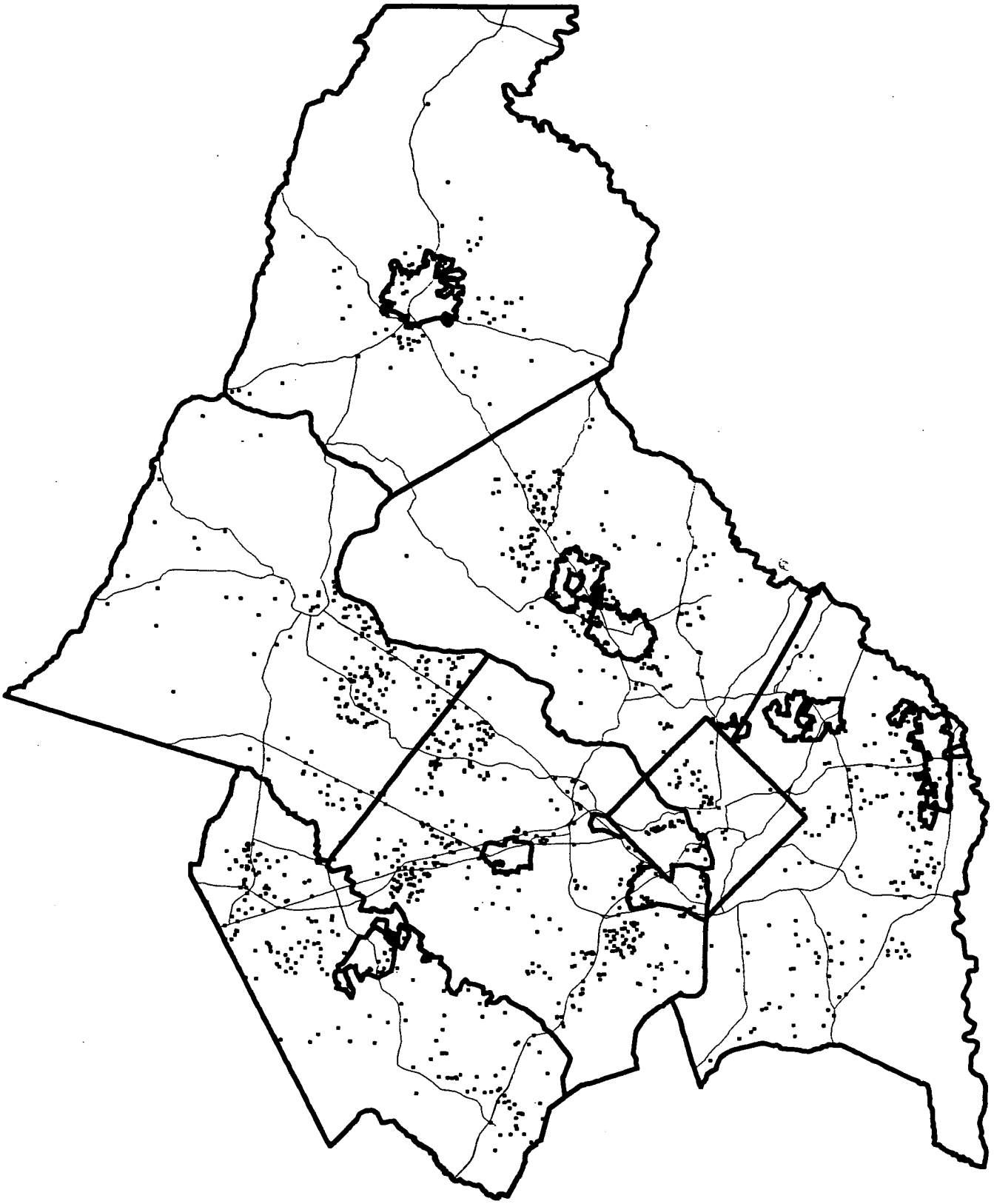
- **Distribution of Growth**

  Figures 1-5 and **1-6** show the distribution of household and employment growth between the Years 1990 and 2020 for the Washington Metropolitan Region. This distribution is based on the Round 6.0 Forecast of the Metropolitan Washington Council of Governments (COG). The effect of the General Plan's guidance is clear from the distribution of the dots in Montgomery County, particularly the employment growth. The effect of the lower concentration of households in relation to activity centers and master planned transit stations is discussed in relation to the Year 2050 scenarios in **Chapter 3.**

Figure1-4: Job and Household Growth

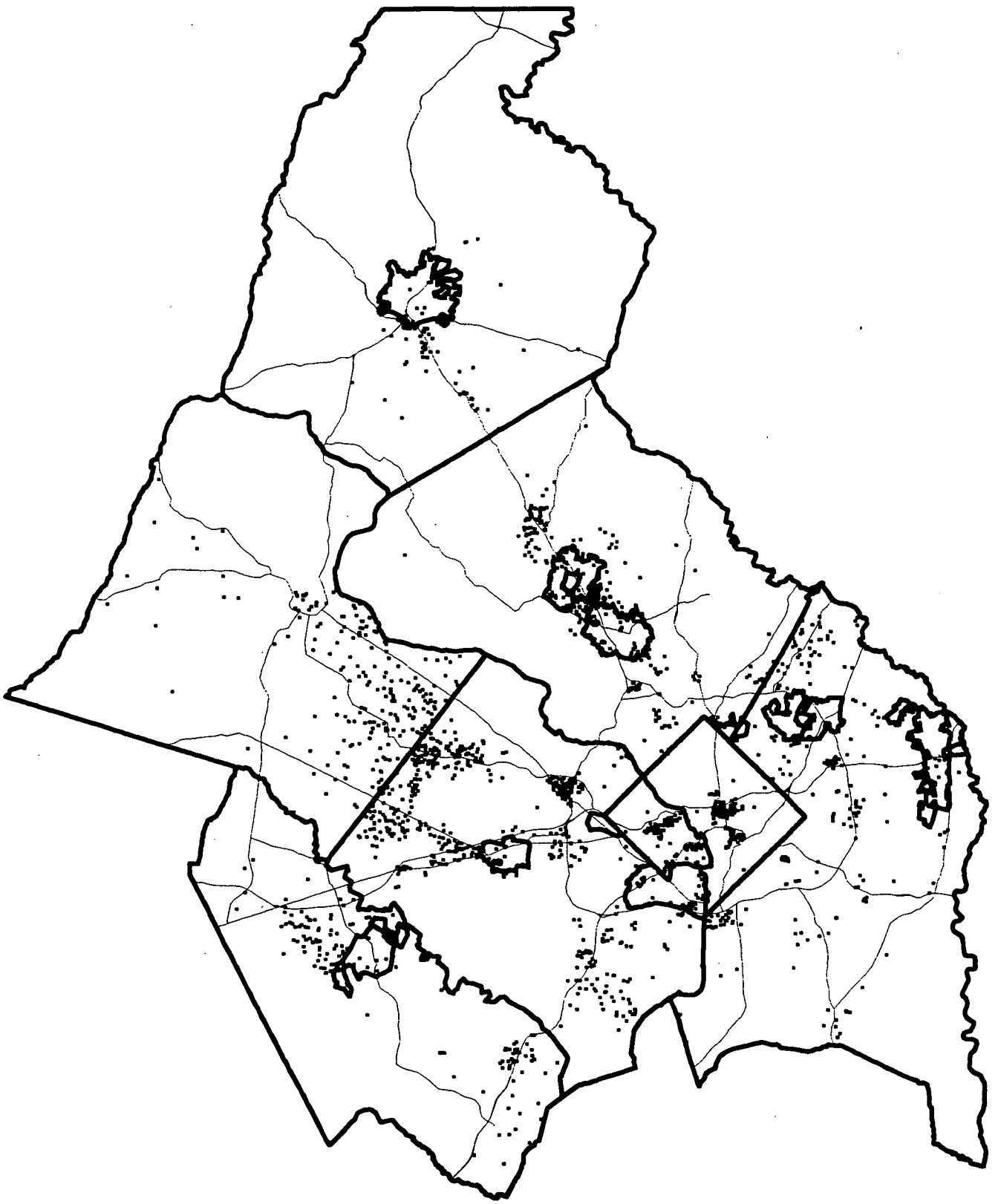


Household Growth, 1990 to 2020
(1 dot equals 500 households)



Source: MWCOG Round 6a Cooperative Forecasts

Employment Growth, 1990 to 2020
(1 dot equals 500 jobs)



Source: MWCOG Round 6a Cooperative Forecasts

Most of the growth in the region and in Montgomery County will be located outside the Beltway, in areas with limited roadway capacity and public transportation services. The region's population is expected to increase by 43% to 5.6 million by the Year 2020. The number of jobs in the region is also anticipated to increase by 43% to 3.5 million in the Year 2020. Between the Years 1990 and 2020, the number of daily trips in the region are expected to grow by more than 65% and the number of vehicle miles driven will increase by more than 75%. The improvements in the current financially constrained long range plan (CLRP) provide for only a 23% increase in the region's highway system between the Years 1990 and 2020, and very little expansion of the transit system during the same period. These findings are consistent with those of this study in relation to future conditions in Montgomery County as indicated in Chapter 3.

The I-270 Corridor is the major growth area for the County over the next 20 years. Much of the rest of the County is nearing completion of its development activity. In terms of households, growth in many planning areas is slowing down and all of the properties will have been developed prior to the Year 2020. Gaithersburg, Germantown and Clarksburg will continue to have significant household and employment development as they continue to grow based on their master plans.

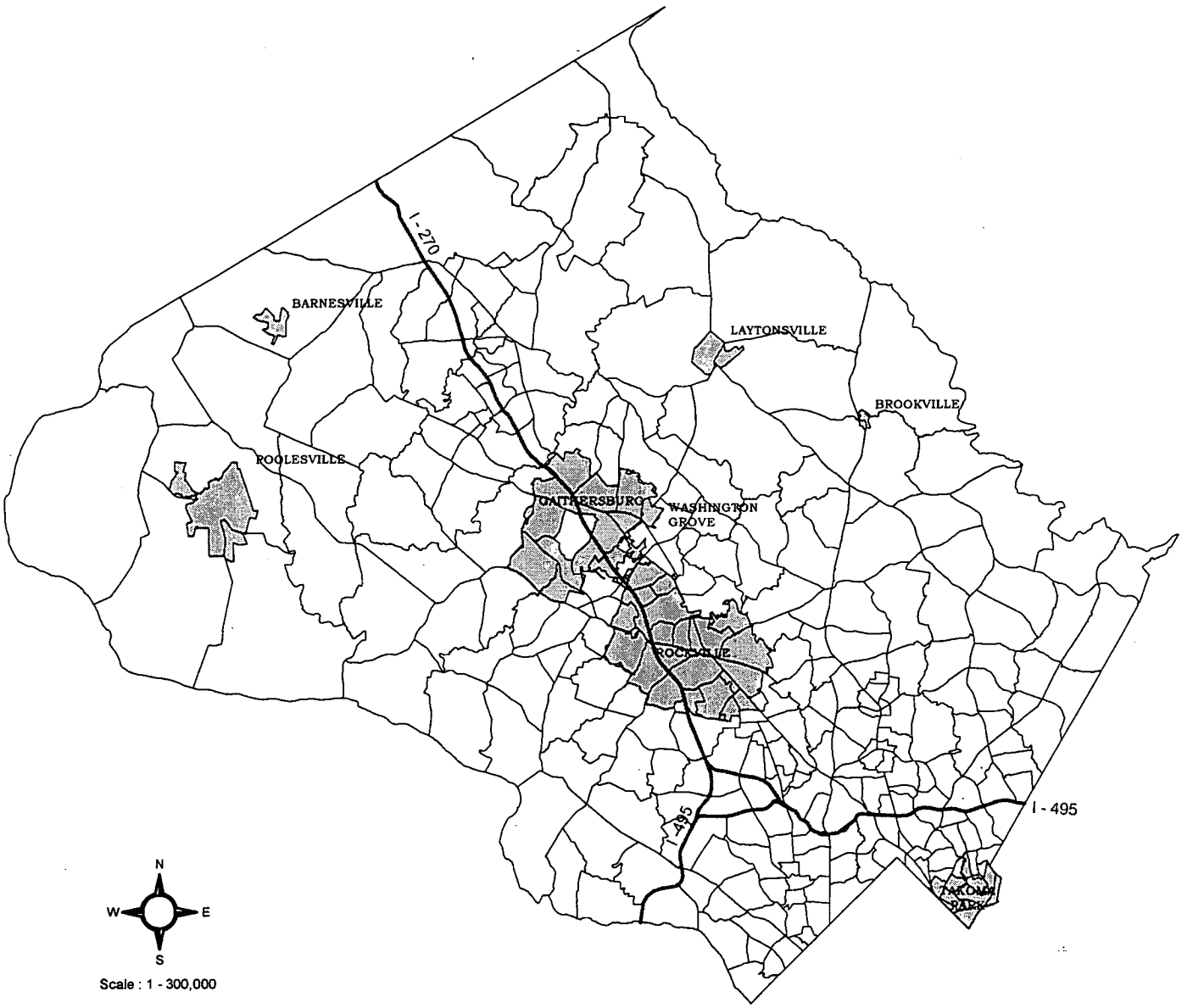
Three-dimensional graphics are used to portray the number and location of households and jobs in each of the traffic zones in the County and the balance of jobs-to-employed residents for each traffic zone. The zones which are a net importer of employees are distinguished from those with more resident employees than at-place employment. **Figure 1-7** shows the traffic zones in Montgomery County and provides a reference for the following three figures.

Figure 1-8 shows the situation in the Year 1998. The situations in Year 2020 shown on **Figure 1-9 and Figure 1-10** indicate the difference between the Years 1998 and 2020. The figures show that the I-270 corridor will be the key area for job growth in the coming 20 years, with housing more dispersed across the County. However, in terms of total jobs, the current activity centers of Silver Spring, Bethesda, Friendship Heights, and North Bethesda will remain important even as I-270 corridor locations increase their totals.

Residential centers are more difficult to identify as densities remain relatively low in most locations, and household locations are spread throughout the County. The figures show high housing totals along the upper portions of the I-270 corridor, in the Silver Spring/Wheaton area and in Eastern Montgomery County. Whereas the County's job centers are generally near Metrorail, the housing tends to be more distant from the jobs and Metrorail stations, making the task of connecting jobs and housing by transit more challenging.

Figure 1-7

Traffic Zones Within Montgomery County



Legend

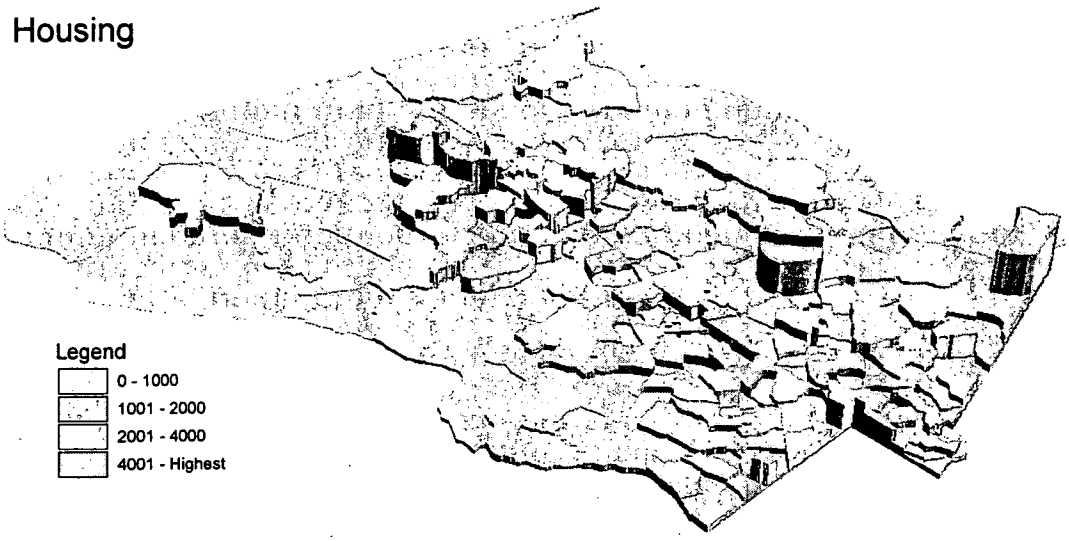
- Interstate Highways
- Traffic Zones
- Municipalities

This is a two dimensional map of traffic zones in Montgomery County. It provides a reference to the three dimensional "3-d" maps that follow. These "3-d" maps were created by tilting the county so that the southern portion of the County is at the lowest level and the northern portion of the County "lifted" by 30 degrees. This tilt distorts the shape of the traffic zones and the County.

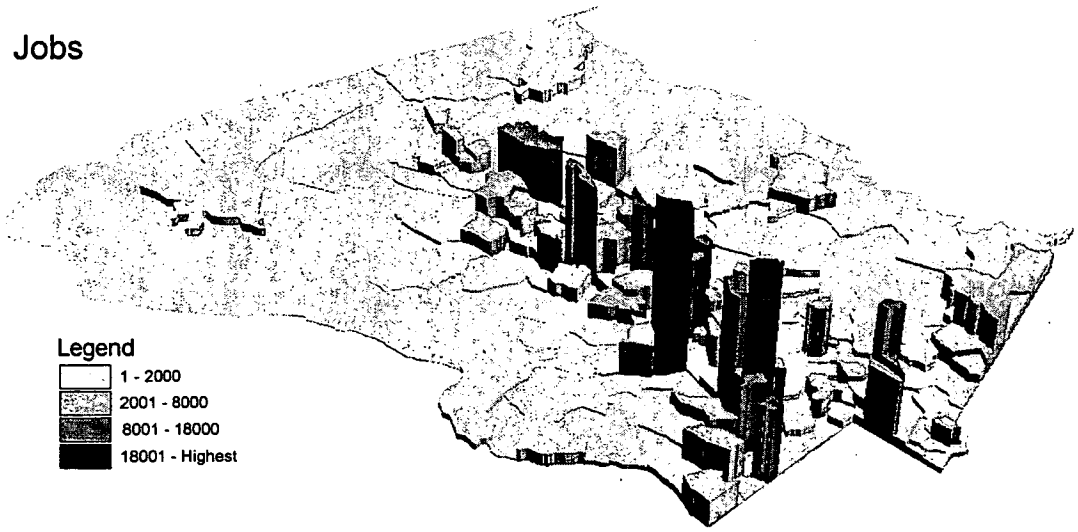
Housing and Jobs in the Year 1998 by Traffic Zones*

Figure 1-8

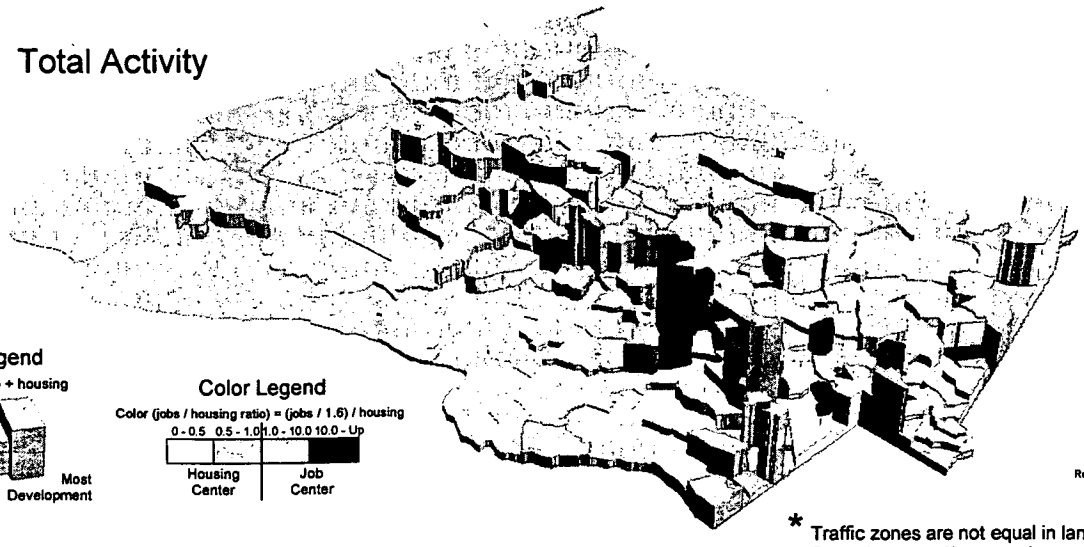
Housing



Jobs



Total Activity



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* Traffic zones are not equal in land area. Some larger traffic zones have a high total number of jobs or housing (such as the high housing on the north east side of the county). These are not maps of development density.

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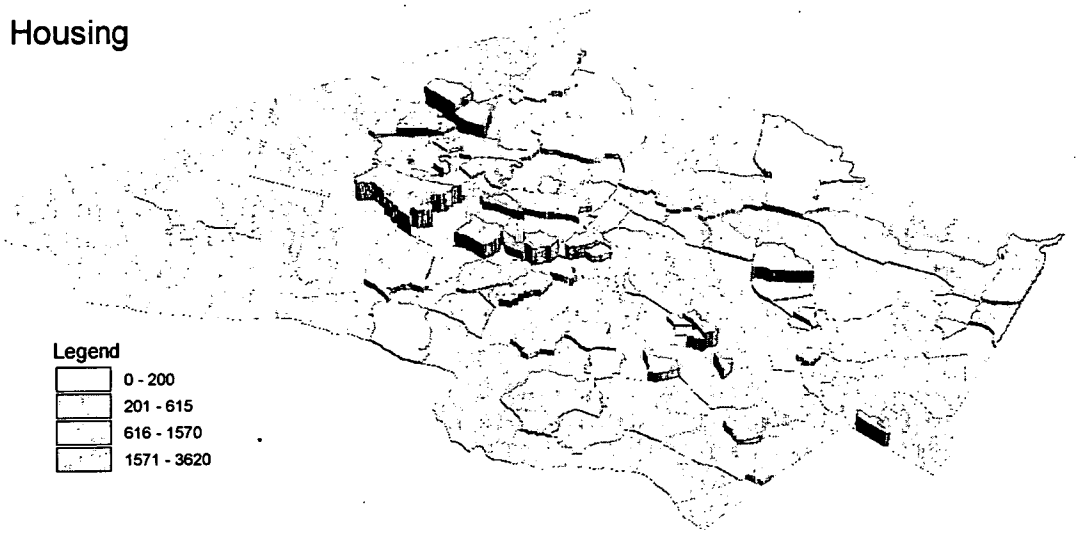
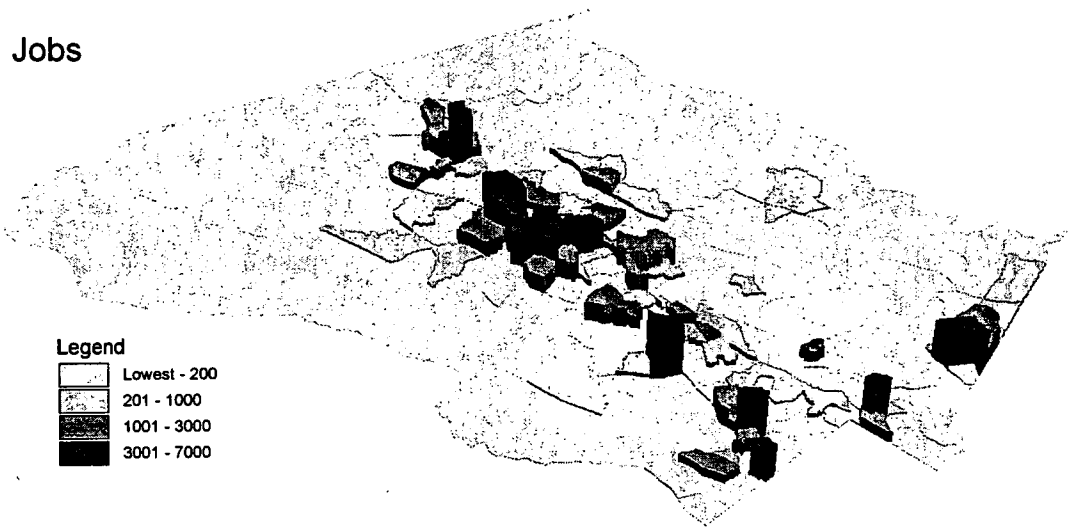
Housing and Job Growth 1998 - 2020 by Traffic Zones*

Figure 1-9

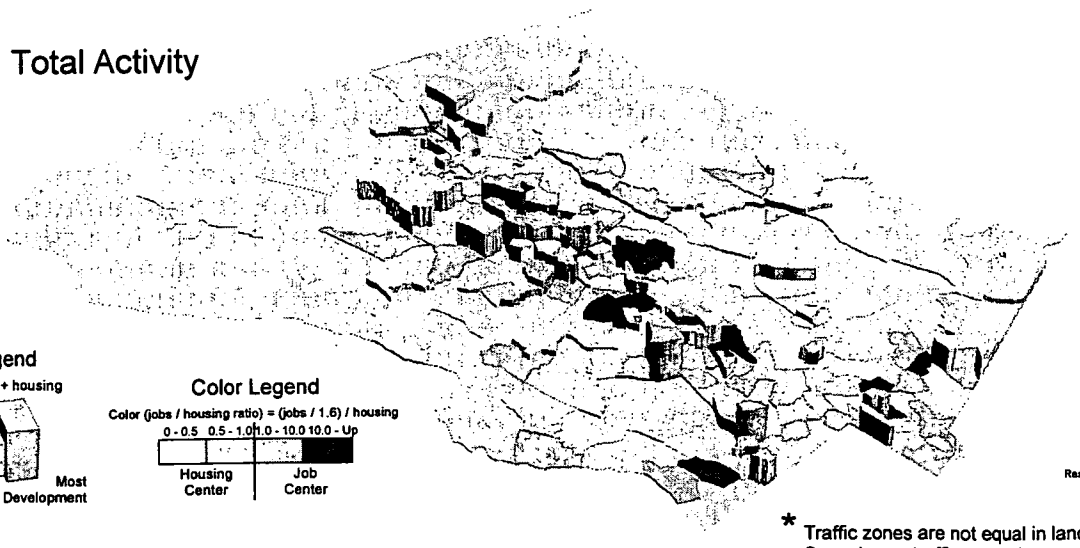
Housing



Jobs



Total Activity



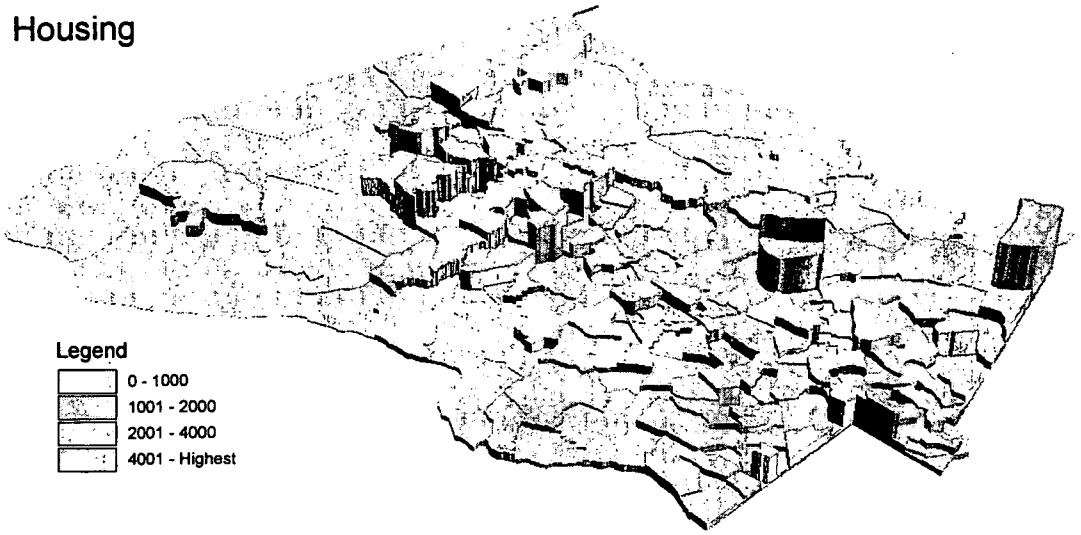
Research & Technology Center

* Traffic zones are not equal in land area. Some larger traffic zones have a high total number of jobs or housing (such as the high housing on the north east side of the county). These are not maps of development density.

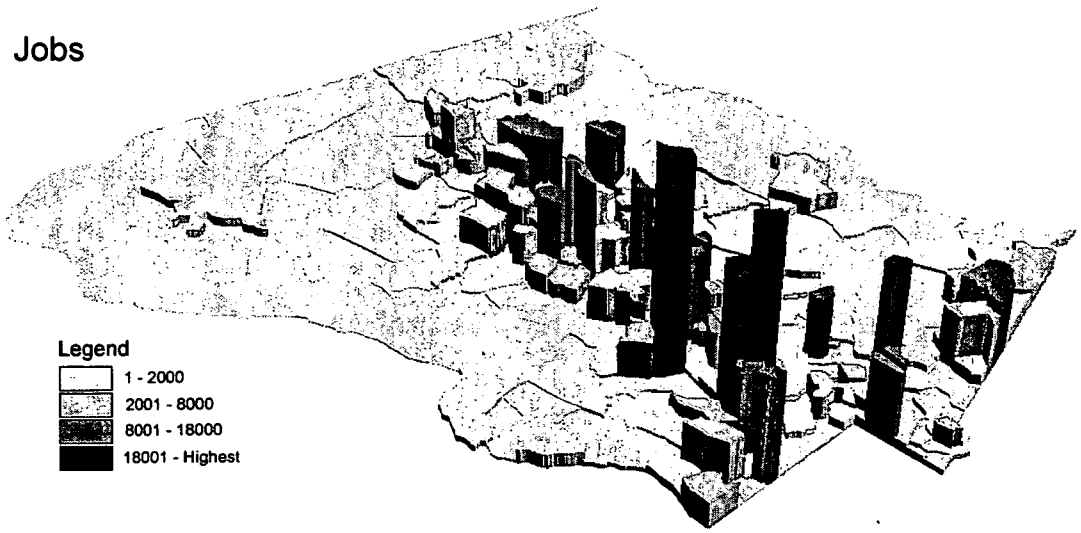
Housing and Jobs in the Year 2020 by Traffic Zones*

Figure 1-10

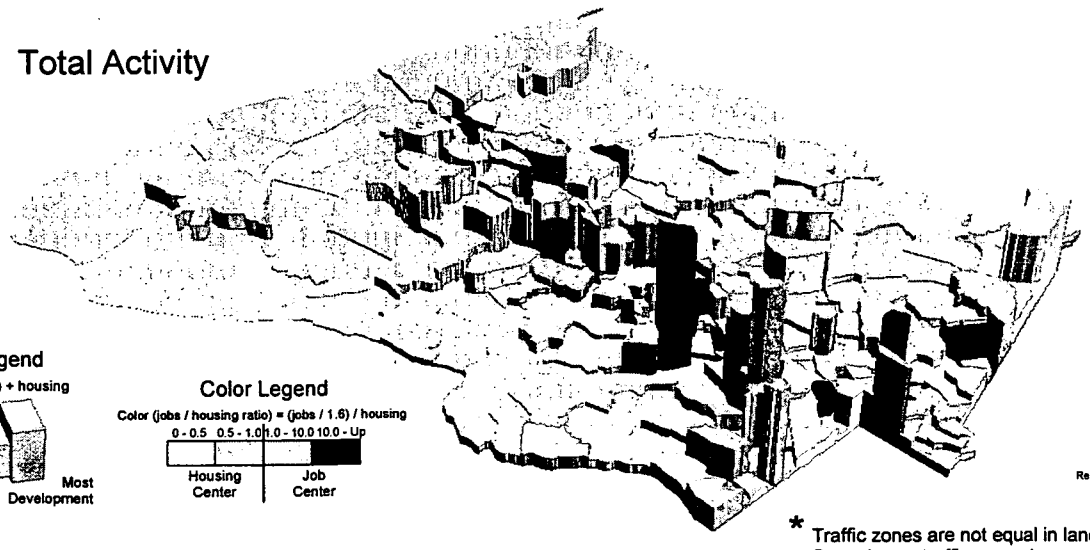
Housing



Jobs



Total Activity



Research & Technology Center

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- **Growth in Transportation Capacity**

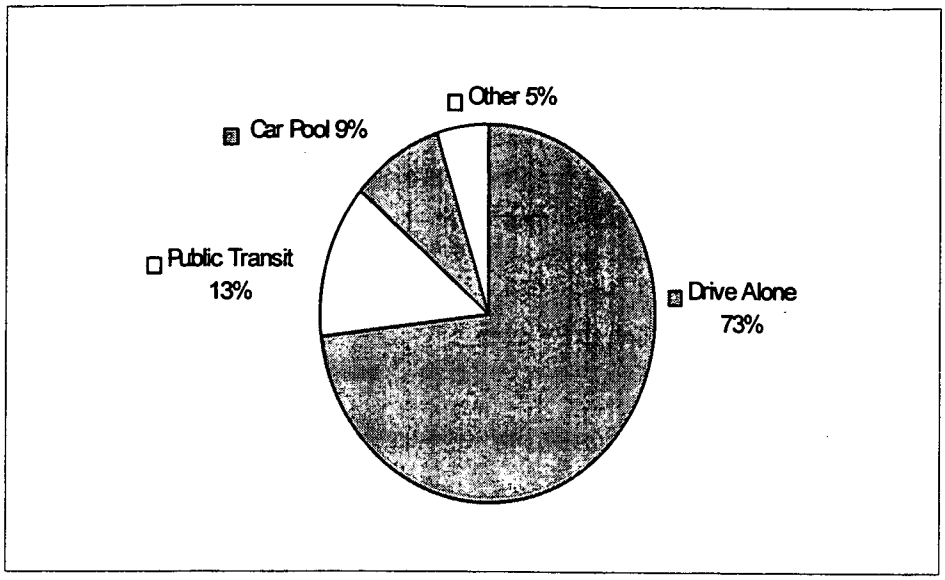
It is difficult to summarize the complex changes that have taken place in the Montgomery County transportation network in the past decades. Many millions of dollars have been spent to construct and expand the State and County roadway network, expand the Metrorail system so that the county portion of the 103-Mile system is complete, and provide extensive Metrobus and Ride-On services. **Figure 1-11** shows the growth in transportation supply and the amount of additional capacity provided, against the potential demand created by the growth in population over the time from 1986 and 1997. Only Ride-On service and the number of new Metrorail stations have matched or exceeded the population growth of 28% over this time.

Figure 1-11: Change In Transportation Supply and Demand: 1986 - 1997

	Percent Change
Population	28
Jobs	23
Transportation Supply	
• State Lane Miles	20
• Municipal Lane Miles	13
• Metro Bus Platform Hours	21
• County Lane Miles	44
• Ride-On Bus Platform Hours	-9.5
• Metro Stations	30

Another indicator of the use of the transportation system is a review of the percent of each "mode" or method of transportation used by workers in Montgomery County based on the most recent Census Update (1998). **Figure 1-12** shows that about 73% of workers continue to drive alone, with 13% using public transit, 9% using car pools, and the remainder walking, biking, or other. Nationally, the percent of commuters driving alone has increased over the past ten years and those taking transit has decreased. In Montgomery County, however, these figures have remained at about the same level for the past ten years. This is in response to the increase in transit services and efforts to encourage non-single-occupancy use through transportation demand management programs of many kinds.

Figure 1-12: Percent Workers Who Drove Alone over the Past Ten Years



5. Current and Future Commuting Patterns

- **Overview**

One of the initial steps in the development of this Report was an evaluation of commuting patterns in 1990 and 2020. The Year 2020 transportation network in this initial review was based on the currently adopted regional CLRP and examined with land uses based on MWCOG Round 5.4 estimates for the Year 2020. Although the future transportation network is relatively constrained when compared with that recommended in this report, the land uses are generally the same, so commuting patterns will remain similar. Staff examined evening peak-hour work-to-home commuting patterns from three perspectives:

- Peak Hour Auto Volumes
- Origins and Destinations
- Transit Mode Shares

- **Commuting Patterns Analysis**

A review of the travel demands on the Montgomery County network in relation to surrounding jurisdictions provides a number of observations for the more detailed analysis described in **Chapters III** and **IV.**

Peak Hour Auto Volumes

The comparison of the patterns for the Years 1990 and 2020 indicates that there are relative and absolute increases in the commuting connections between Montgomery County (particularly the I-270 Corridor) and Northern Virginia, and in the commuting flows between the I-270 Corridor and Prince George's County. There is a decrease in the relative commuting traffic on the Beltway in Montgomery County between Northern Virginia and Prince George's County. **Table 1-2** shows volumes developed by MWCOG.

Table 1-2: Increase in Roadway Volumes: 1990 and 2020

Roadway	1990	2020	Percent Increase
American Legion Bridge	202,000 ADT*	325,000 ADT	61%
I-495 in Montgomery County	182,000	227,000	25%
I-270	113,000	215,000	90%
US 29	48,000	99,000	106%

* ADT = Average Daily Traffic Source: MWCOG

Origins and Destinations

Travel by Montgomery County residents to Montgomery County jobs is and will continue to be the major commuting travel. There are also significant numbers of commuters traveling to and from Montgomery County. For both Years 1990 and 2020, the percent of commuters coming into the County is similar to the number of resident workers going out of the County. Of particular interest are the commuting trips across the American Legion Bridge. In both the Years 1990 and 2020, the percent in and out are roughly similar for trips to and from both Fairfax and Loudoun Counties.

In **Figures 1-13 and 1-14** there are two arrows connecting Montgomery County and the other eight jurisdictions in the study region. The percentages are related to the total number of trips in the evening peak period coming into Montgomery County. The "IN" arrow represents the trips coming back to residences in Montgomery County from jobs in other jurisdictions during the evening peak hour. The "OUT" arrow represents those who work in Montgomery County and are returning home to the other jurisdictions. In that the number of trips in each direction is different, reflecting the differences in the number of jobs and the number of employed residents, the percentages represent different volumes. There are also two arrows representing the trips of those who both live and work in the County. Although the number of trips is the same, the percentages are different because they are based on different total numbers of trips. In 1990 there were 134,000 trips to Montgomery County in the evening peak hour and 137,000 trips

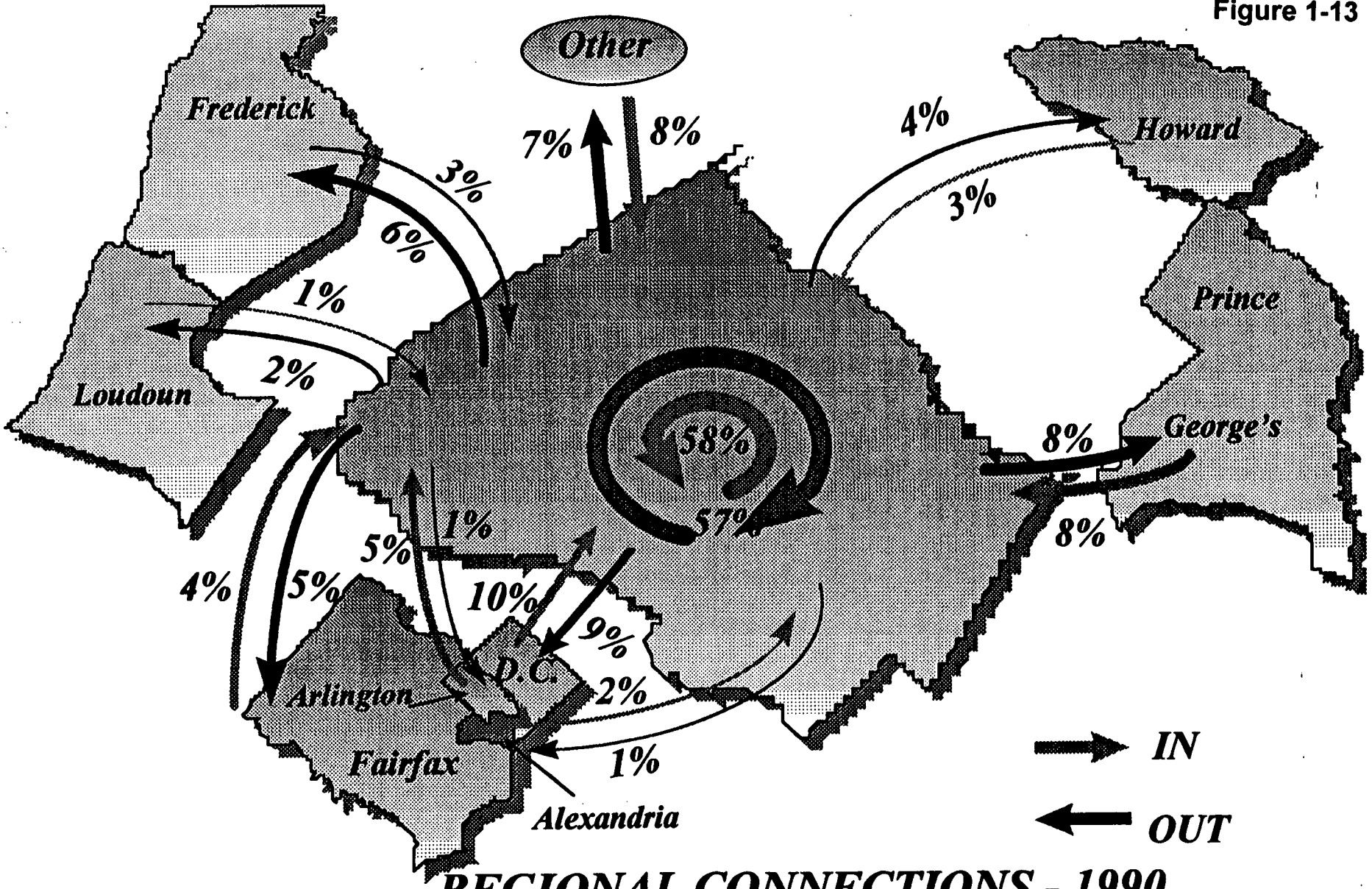
from Montgomery County. These numbers are expected to increase to 212,000 and 206,000 respectively. The evening peak-hour trips within Montgomery County were 78,000 in 1990 and are expected to increase to 123,000 in the Year 2020. By the year 2020, the percent of Montgomery County residents traveling to jobs within the County will increase only slightly.

Between the Years 1990 and 2020 most of the percentages of Montgomery County residents working in other regional jurisdictions and of Montgomery County jobs being held by residents of other jurisdictions remain consistent. There are increases in the connections in both directions with Howard County, but decreases in both directions with 'Other' areas. The proportion of Montgomery County's resident work force working in the District of Columbia decreases over the thirty-year period.

Transit Mode Shares

Also from the commuting analysis is the finding that the transit mode shares for Montgomery County and Arlington are the only jurisdictions in which there is an increase between Years 1990 and 2020. The extension of the Metrorail Red Line to Glenmont and the Georgetown Branch Transitway contribute to the increase in Montgomery County. In Arlington, the extensive developments at the stations on the Metrorail Orange Line contribute to its increase in transit mode share.

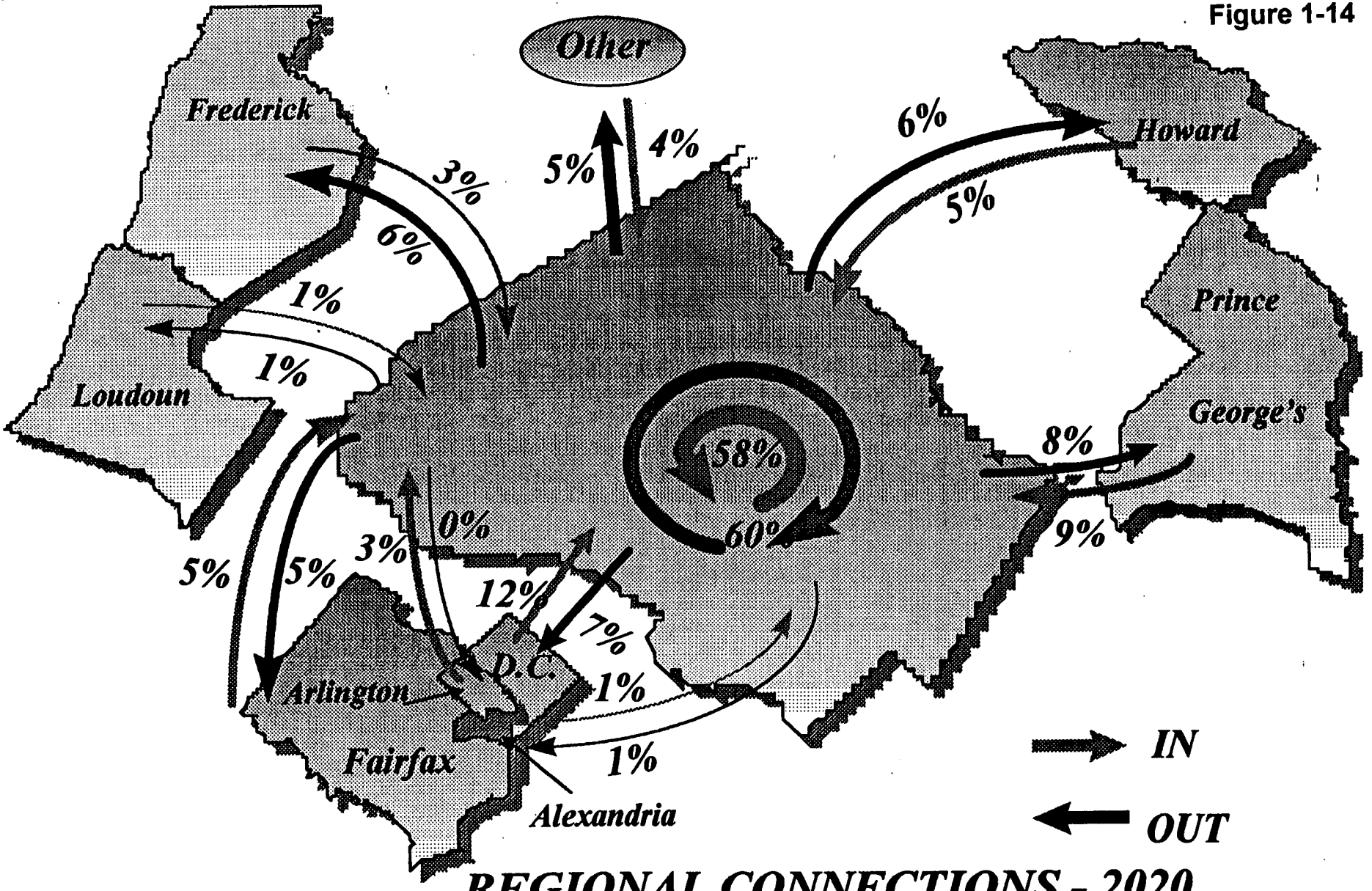
Figure 1-13



REGIONAL CONNECTIONS - 1990

PERCENTAGE DISTRIBUTION OF AUTO TRIPS

Figure 1-14



REGIONAL CONNECTIONS - 2020

PERCENTAGE DISTRIBUTION OF AUTO TRIPS

Chapter II: Findings and Recommendations

1. Introduction

This Chapter brings together information from all parts of the report. Details can be found in other Chapters and in the Appendices. The study recommendations are in several groups:

- Projects for MD CTP FY 2000-20005
- Review of Transportation Solutions Group and County Policy Implications
- Recommended Year 2020 transportation network and projects
- Next steps for study and planning.

Because of the sketch-planning nature of this analysis, many details on projects are not resolved. The recommendations are intended to form the basis for public debate and discussion. Also, as noted in "Next Steps," analysis continues on the effects of policy changes, and more details will be available later this fall.

The staff recommendations were developed following review of the results of the initial four combination alternatives. This allowed the combination of the most effective links and modes into a future network that could then be compared against those networks previously evaluated. The "Findings" below present much of the big-picture review that went into developing the Recommended Plan.

2. Summary of Findings

- Land use patterns for 2020 are expected to be generally as reflected in the Adopted Round 6 MWCOG Year 2020 forecasts. Substantial growth will occur throughout the region. In Montgomery County, total jobs and households are increasing overall, with the I-270 corridor including Clarksburg expected to have the greatest percentage growth. Total jobs will grow from 491,000 in 1998 to 630,000 in 2020, with households increasing from the 1997 308,000 to 390,000. The key activity centers of Silver Spring, Bethesda, Friendship Heights and parts of North Bethesda will continue to be important job centers. Housing locations will be more dispersed over the County.

- No major changes are anticipated in factors that would influence the balance between transit and auto use. The study assumes the current fiscal ratios which influence auto use such as gasoline costs and parking costs, and those that influence transit use such as fares, would stay constant. This does not have to be the case, however, and this balance is discussed in the sections concerning potential policy changes at the end of this Chapter.

- Congestion will grow in the County under any future transportation scenario. Based on the transportation model simulation in the evening peak hour, lane miles of the arterial roadway and freeway network operating at a congested level will increase from about 9.8% in 1998 to 20.6% with the current CLRP network. This situation can be improved with some additional infrastructure, but not back to 1998 levels.

- Future transit and roadway travel is strongest in the radial directions, reflecting the current and planned locations of jobs and households along existing radial corridors (I-270, MD 355, US 29, Georgia Avenue). Transit use is generally not heavy in circumferential (cross-County) directions because of the dispersed travel patterns being served. Providing efficient transit in circumferential directions remains best done by bus services on shared HOV/Bus Lanes as part of new or expanded existing roadways. The Metrorail system provides a key framework for future transit services, and any transitways, either bus or rail, should connect to the system in a manner that provides for easy transfers.

- An exception to the lower relative circumferential ridership is a good quality link between the two legs of the Metrorail Red Line. There is strong potential ridership between these two legs, because of the number of jobs and households accessible along each, and the long current transit travel time between them via downtown D.C. Wherever it is provided, inside or outside the Beltway, the link shows strong demand. The Georgetown Branch Trolley better supports development and travel in County activity centers serving the key CBDs of Bethesda and Silver Spring, and thus was the choice of staff for the Recommended Plan.

- Heavy rail (Metrorail) extensions do not seem warranted by demand in the County, although light rail is feasible and desirable in the 2020 future. It is possible some long-term alignment that was primarily underground (such as the proposed outer "purple line") would be best accomplished with Metrorail rather than light rail; this would be determined from more detailed study of that alignment. The recent proposal to build a Metrorail link on the Capital Beltway was not specifically evaluated in this study due to its very recent introduction. However, existing and planned major activity centers are not on or close to the Beltway. Effective use of a Beltway Metrorail would require parking lots and bus stations to connect the rail to the other locations passengers wish to go. The key value of Metrorail would be inter-operability, allowing trains to operate between lines. Well-designed transfers between light rail and Metrorail could, however, overcome concerns about the importance of one-mode trips made possible with rail inter-operability.

- The network of improvements proposed by the Montgomery County Council provides an excellent starting point for a Year 2020 network. Added to the Council projects was the Capitol Beltway HOV/Bus Lane in each direction, a busway in the median of Georgia Avenue, the North Bethesda transit connection to Rock Spring Park, supportive policies, and some additional major roadways and interchanges. This enhanced network emerged as the staff recommendation after comparison against a number of different network approaches and review of their measures of effectiveness.

- Staff believes that future transit networks should be structured to emphasize the accessibility of housing to job centers as a key consideration. County job centers tend to be already fixed, with good public infrastructure and zoning to support accompanying retail and other uses, and with relatively good access to transit and roads. Building transit lines to bring housing closer from a time perspective to these centers is good public policy; this was a key criteria in the decisions made in developing the Staff Year 2020 Recommended Network.

- The US 29 Transitway between Silver Spring and Burtonsville was not recommended for the Year 2020 network although the potential transit ridership along this corridor is high. Bus service in this corridor is good, and park-and-ride lots capacity is available. The US 29 interchanges now under design will bring significant travel improvements to this corridor, which will be shared by buses. Providing a good transit connection to the Food and Drug Administration site in White Oak, one of the future major job centers, appears difficult. There does not appear to be a feasible solution to the problem of a high-quality transit connection between Four Corners and downtown Silver Spring and, until this is resolved, it is not worthwhile to do additional planning for other portions of the route. If a solution to this connection can be found in the future, the addition of this link as light rail or busway should be considered.

- Similarly, a transit connection directly between central Montgomery County, such as Wheaton, and northern Prince Georges County as provided by the Outer Purple Metrorail line was not seen as needed in the next 20 years. The current Metrorail system provides this connection via the Red Line-Green Line connection, and an additional line draws trips away from the current Metrorail system. In the long-term, as more development occurs, an additional connection may be more viable. The analysis did show a need for better transit access from eastern Montgomery County to Langley Park and College Park areas; this need could be served by express bus services using US 29 and a new Beltway HOV/Bus Lane.

- A separate transitway connection to the Tysons Corner area of Northern Virginia is also not in the 2020 network. Transit forecasts did not justify this link in the 20-year horizon and, with virtually no planning underway at this time to identify a potential alignment, it is very unlikely that the link could be provided in this time frame. The Beltway HOV/Bus Lanes can, and should, provide high-quality bus services between selected Montgomery County and Northern Virginia locations; this was a factor in recommending these lanes be provided in the 20-year network.

- Under almost all of the Measures of Effectiveness, the Max Build (Combination Network 4) performs best. This is because that alternative contains virtually every capital project proposed, including both a new inner and outer transitway line (light rail on surface or subway). This network is seen as prohibitively expensive and not feasible for a Year 2020 plan. Supporting this finding was the analysis in Chapter IV showing this network not ranking well in terms of cost-effectiveness -- improvements per unit of cost.

3. Recommended Year 2020 Transportation Projects

Relying on the these findings and other information, staff recommends of improvements shown on **Figure 2-1** and detailed in **Table 2-1** as the goal for the County in the next years. The improvements in this Recommended Year 2020 Network would be included in the CLRP of MWCOG and moved toward implementation in an appropriate process. Many of the roadway projects are in the 1998 CLRP (noted by an * on the table), while the only transitway project in the CLRP is the Georgetown Branch Trolley/Trail. Key projects are described below.

- **Transit Connections**

  Georgetown Branch Trolley/Trail: light rail from Bethesda to Silver Spring. This provides a much-needed connection between the two ends of the Metrorail Red Line, and has environmental impacts that can be mitigated.

  Corridor Cities Transitway: Light Rail from the Shady Grove Metrorail station to COMSAT in Clarksburg. This light rail line would serve a variety of medium density uses in the important I-270 corridor.

  North Bethesda Transitway with a high quality transit connection between the Grosvenor Metrorail station and the Montgomery Mall area. This provides a short-trip transit connection between one of the County's largest jobs centers, retail mall and thousands of housing units and a Metrorail station (with adjacent high-density housing nearby and additional planned). This can be the start of a future outer transit "purple line."

STAFF'S YEAR 2020 NETWORK

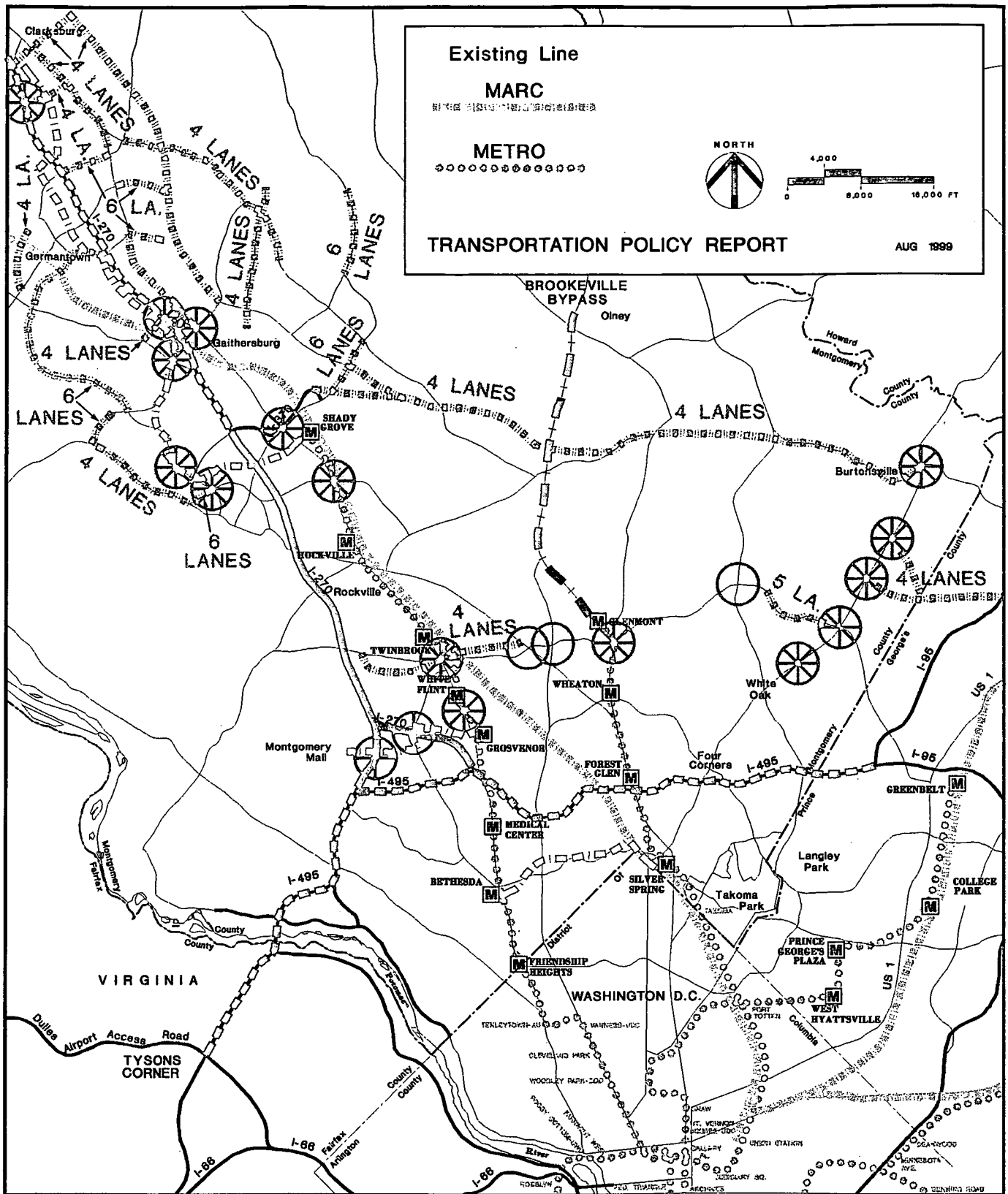


Table 2-1: Facilities in the Recommended Network
(including facilities in 1998 CLRP as indicated with an asterisk)

Rail Transit

- Corridor Cities Transitway between Shady Grove Metro station and COMSAT
- * Georgetown Branch between Silver Spring Transit Center and Bethesda Metrorail station
- North Bethesda Transitway between Grosvenor Metro station and Montgomery Mall

Busways

- Georgia Ave Busway between Glenmont Metro station and Olney

HOV and Bus Lanes

- I-270 southbound between I-370 and Clarksburg Rd (MD 121)
- I-270 between Clarksburg Rd (MD 121) and Frederick County Line
- I-495 between I-95 and American Legion Bridge

Roadways

- * Bordley Dr between Georgia Ave (MD 97) east to existing Bordley Dr: construct to 2 lanes
- * Briggs Chaney Rd between Gateshead Manor Way to Prince George's County line: widen to 4 lanes
- * Briggs Chaney Rd, reconstruct/realign at New Hampshire Ave (MD 650) opposite Norwood Rd
- * Briggs Chaney Rd between Aston Manor Dr and Gentry Ridge Ct: reconstruct to 4 lanes
- * Briggs Chaney Rd between Auto Blvd and Aston Manor Dr: widen to 4 lanes
- * Brink/Wightman Rd, Ridge Rd (MD 27) to Goshen Rd: reconstruct-4 lanes
- * Chapman Ave between Bou and Executive Blvd: extend to 4 lanes
- * Clopper Rd (MD 117), Existing Germantown Rd (MD 118) to relocated Germantown Rd (included in MD 118 relocated): reconstruct 6 lanes
- Darnestown Rd (MD 28) between Riffleford Rd and Muddy Branch Rd: widen to 4 lanes
- * Darnestown Rd (MD 28) between Muddy Branch Rd and Great Seneca Hwy (MD 119): widen to 6 lanes
- Darnestown Rd (MD 28) between Key West Ave and Riffleford Rd: widen to 4 lanes
- Fairland Rd between Columbia Pk (US 29) and Briggs Chaney Rd: widen to 4 lanes
- * Father Hurley Blvd. between Wisteria and Germantown Rd (MD 118) relocated: construct as 4 lanes
- * Father Hurley/Ridge Rd between I-270 and existing Ridge Rd (MD 27): widen to 6 lanes
- * Frederick Rd (MD 355) between Montgomery Village Ave (MD 124) and Middlebrook Rd: widen to 6 lanes
- * Frederick Rd (MD 355) between Ridge Rd (MD 27) and Stringtown Rd (MD 121): widen to 4 lanes
- * Georgia Ave (MD 97) Brookeville Bypass
- * Germantown Rd Extended (MD 118) between Frederick Rd (MD 355) and Scenery Dr: widen to 6 lanes
- * Germantown Rd Extended (MD 118) between Scenery Dr and Midcounty Hwy (M-83) /Watkins Mill Rd: construct as 3 lanes
- * Goshen Rd between Girard Street and Warfield Rd: widen to 4 lanes
- * Great Seneca Hwy (MD 119) between Middlebrook Rd and Montgomery Village Ave (MD 124): widen to 6 lanes
- Midcounty Highway (M-83) between Montgomery Village Ave and Stringtown Rd (MD 121): extend as 4 lanes
- * Middlebrook Rd Extended between Frederick Rd (MD 355) and Midcounty Hwy (M-83): widen to 6 lanes
- * Middlebrook Rd between Great Seneca Hwy (MD 119) and I-270: widen to 6 lanes
- * Montrose Parkway between I-270 and Rockville Pk (MD 355): construct as 4 lanes
- * Nebel Street Extended between Randolph Rd and Bou Ave: construct as 4 lanes
- * New Road between I-370 and Georgia Ave/Layhill Rd: construct as 4 lanes

* New Road between Columbia Pk (US 29) and Baltimore Ave (US 1): construct as 4 lanes
- Newcut Rd between I-270 and Frederick Rd (MD 355): construct as 4 lanes
- Norbeck/Spencerville Rd between Georgia Ave and Columbia Pk (US 29): widen to 4 lanes (includes portion currently in CLRP)
* Quince Orchard Rd (MD 124) between Ridge Rd (MD 28) and Longdraft Rd: widen to 6 lanes
* Randolph Rd between Buckhart St. and Old Columbia Pike: widen to 5 lanes
* Shady Grove Rd between Briardale Rd and Muncaster Mill Rd (MD 115): widen to 6 lanes
* Snouffer School Rd between Gosher Rd and Centerway Rd: widen to 4 lanes
* Stringtown Rd Relocated (MD 121) between Frederick Rd (MD 355) and Midcounty Hwy (M-83): widen to 4 lanes
* Stringtown Rd Relocated (MD 121) between I-270 and Frederick Rd (MD 355): construct as 4 lanes
* Valley Park Dr between east of Ridge Rd (MD 27) and existing Valley Park Dr: construct as 2 lanes
* Watkins Mill Rd between Clopper Rd (MD 117) and Frederick Ave (MD 355): construct as 4 lanes
* Woodfield Rd between Warfield Rd and Airpark Rd: widen to 6 lanes
* Woodfield Rd Extended (MD 124) between Damascus Rd and (MD 108) and Ridge Rd (MD 27): construct as 2 lanes

Interchanges

* I-270 @ Montgomery Village Ave (MD 124)
- I-270 @ Newcut Rd Extended
* I-270 @ Rockledge Dr Connector
- I-270 @ Watkins Mill Rd Extended
* I-270 Spur @ Fernwood Rd/Democracy Blvd; reconstruct
* I-270 Spur @ Old Georgetown Rd (MD 187) reconstruct
* Georgia Ave (MD 97) @ Randolph Rd
* Clopper Rd (MD 117) @ Quince Orchard Blvd (MD 124)
* Columbia Pk (US 29) @ Briggs Chaney Road: construct
- Columbia Pk (US 29) @ Fairland Road: construct
- Columbia Pk (US 29) @ Montrose Road/CSX
* Columbia Pk (US 29) @ Randolph Road/Cherry Hill Road; construct
- Columbia Pk (US 29) @Tech Road
* Columbia Pk (US 29) @ Spencerville Rd (MD 198)/Blackburn Road: construct
- Frederick Rd (MD 355) @ Gude Dr
- Frederick Rd (MD 355) @ Montgomery Village Ave
- Frederick Rd (MD 355) @ Shady Grove Road
- Frederick Rd (MD 355) @ Nicholson Lane
- Great Seneca Hwy (MD 119) @ Ridge Rd (MD 28)
- Great Seneca Hwy (MD 119) @Sam Eig Hwy

Intersections

- Randolph Rd @ Connecticut Ave
- Randolph Rd @ New Hampshire Blvd
- Randolph Rd @ Veirs Mill Rd

Other

* Burtonsville Transit Center
* Damascus Park-n-Ride
* Four Corners Transit Center
* Germantown Transit Center
* Lake Forest Transit Center
* MARC North Bethesda Station
* Olney Transit Center

* Shady Grove West Transit Center
* Silver Spring Transit Center
* White Oak Park-n-Ride

Capital Beltway HOV/Bus Lane: one lane each direction from the American Legion Bridge to I-95. This provides movement capacity for carpools and buses along this critical travel link, and assumes access via the current roadway network and no changes to the land-use plans. Expanded bus services would be operated to connect high-demand locations such as the current Tysons Corner to Shady Grove buses. In the future, a direct ramp connection from an HOV/Busway Lane to a Metrorail station would be desirable, with Forest Glen being the initial choice if neighborhood compatibility issues can be accommodated. This would provide a valuable "network" connection.

Georgia Avenue Busway: from Glenmont Metrorail to Olney. This connection showed high future travel demand and provides a bus alternative along a potentially very congested roadway link in the future. Express and local services could use the two-way recommended busway.

Extend the I-270 HOV Lanes: from the Montgomery County line to MD 121 to complete a link to the Capital Beltway. (Extensions more toward Frederick City should be determined as part of the I-270 study underway by SHA).

- **Roadway Connections**

  - Construct a new four-lane roadway connecting I-370 or Midcounty Highway to Georgia Avenue or Layhill Road, using the previous ICC right-of-way with appropriate environmental mitigation. There continues to be a need for east-west roadway travel, and no other alternative seems feasible in this section of the County. The western end can connect to I-370 or directly to Midcounty Highway. There is a high level of existing congestion on MD 28 and on MD 115 caused by residents along Georgia Avenue traveling to jobs in the I-270 corridor. The Aspen Hill planning area is under a moratorium on the approval of new subdivisions in the current AGP.

- Widen MD 198 to four lanes between Layhill Road and US 29 in accordance with master plans. This additional capacity is needed to accommodate increased east-west movement, as can be seen by the high congestion levels now on Randolph Road and Bonifant Road. Eastern Montgomery County is under a moratorium on the approval of new subdivisions in the current AGP.

- Provide the planned roadway between US 29 and US 1 in Prince George's County. Increased connections between these two key travel routes will allow for I-95 to be more of a alternative for some trips which now use US 29.

- Construct planned roadway improvements in parts of the County that are expected to grow significantly in the future, particularly in the I-270 corridor; all of these roadways are already included in the applicable master plans. These are not seen as competing with the transit, but are needed to keep congestion levels at acceptable levels. Additions to the current CLRP include:

  - Newcut Road between I-270 and MD 355
  - Darnestown Road between Key West Avenue and Riffleford Rd

- Construct Montrose Parkway between I-270 and Veirs Mill Road, including a grade separation of Montrose/Randolph Roads at MD 355 (part of an SHA analysis). The Montrose Parkway is a County project. The grade separation of Montrose/Randolph Roads over MD 355 is an SHA project. The two are being coordinated to assure compatibility to aid needed access and circulation to the Rockville Pike corridor.

- Complete Midcounty Highway Extended (M-83) from the current terminus at Montgomery Village Avenue to Clarksburg

- Plan for grade separation at several locations to mitigate extremely high levels of congestion both now and in the future. These include:

  - I-270 at Newcut Road and at Watkins Mill Road
  - Georgia Avenue at Randolph Road
  - MD 355 at: Gude Drive, Montgomery Village Avenue, Shady Grove Road, Montrose Road/Randolph Road, Nicholson Lane
  - Clopper Road at Quince Orchard Boulevard.

Construct six of the US 29 grade separations in the Recommended Plan:

- MD 198
- Briggs Chaney Road
- Blackburn Road
- Fairland Road
- Randolph Road
- Tech Road.

These grade separations will create a freeway-type facility that will help communities be better connected by providing easy east-west movement and removing what are even now significant auto delays. Buses will be able to use the queue-jumper shoulder lanes if necessary, and generally take advantage of the improved movement for all vehicles.

4. Recommended Transportation Projects for Next Maryland Consolidated Transportation Program (FY 2000-2005)

The overall list of future projects must be prioritized to identify the few that would be recommended to the Governor and General Assembly for inclusion in the upcoming five-year capital program. Staff is very sensitive to the need for a more extensive transit network in the County, of identifying high-priority needs, and the importance of having projects in the CTP that can be actually constructed in the time period under consideration. The CTP must also be used to fund new project planning activities and to prepare the subsequent transportation projects. This list was developed to focus resources on supporting existing activity centers and relieving existing congestion. The projects selected are important parts of the future networks. One consideration for this list is that projects be far enough along in the project planning phase to warrant their inclusion for construction funds in this five-year cycle.

Staff recommends the following projects to the County Council and County Executive for inclusion for construction in the upcoming Maryland CTP FY 2000-2005.

- Montrose Road/Randolph Road overpass over MD 355 and CSX tracks
- US 29 grade separation at MD 198, and at Briggs Chaney Road
- Georgetown Branch Trolley and Trail, for completion of EIS and beginning of construction between Silver Spring and Bethesda as a light-rail connection

Some of the intersection improvements in the second phase of the state Congestion Relief Study may also be valuable for funding, but they have not been specifically identified in this plan. Staff will research these improvements and provide more information when the Planning Board considers this topic in September.

Staff also recommends that the CTP include funds to complete planning and design of the Corridor Cities Transitway between Shady Grove and an initial interim station, probably Germantown, with eventual completion to a station in the Clarksburg area by 2020. This is staff's next priority for construction.

5. Effectiveness of Recommended Plan

The Recommended Plan emerged from the analysis after a multiple-phase process which considered a number of different modes and alignments. **Details of the MOEs are summarized in Table 4-1, showing the effectiveness of the Recommended Network against 1998 conditions, the Year 2020 Base Case (current CLRP) and four combination alternatives.**

Although the combination alternative networks were tested, they were, of course, made up of individual projects. Given time and resource constraints, it was not possible to separately test each project; conclusions had to be drawn on projects by comparing results among alternatives and considering TPR goals as well as other County goals and needs. A defining principle was that this is a plan that should be implemented in the next 20 years, and should also create a network that can be improved upon over time, even beyond the 20 years. The findings noted above, along with reviews of the detailed MOEs, were used to structure the Recommended Network.

Upon evaluation, the Recommended Year 2020 Network:

- reduces Vehicle Hours of Travel (delay) over the base case better than any except the Max Build,
- has excellent cost efficiency for capital costs on key effectiveness measures
- is consistent with County plans
- strongly supports household access to jobs in activity centers
- provides a balanced, multi-modal approach to meeting differing travel needs
- provides rail transit service to four of the top eight Montgomery County activity centers, including two where rail is not available today (Life Sciences Center and Rock Spring Park). Therefore, it uses rail where appropriate to serve current activity centers and support clustering for future growth.

6. Review of Transportation Solutions Group Report and County Policy Implications

This report acknowledges that there is no "silver bullet" to solve the transportation problem. The Transportation Solutions Group (TSG), a committee of national and local experts, was appointed by the Governor to address transportation challenges in suburban Maryland. The Group recognized that congestion is the result of the location and density of land use and the economics that result from taxing and pricing policies, as well as the supply of transportation facilities. The TSG developed recommendations aside from additions to the

supply of transportation facilities that fairly well covered the range of policy options that affect transportation demand.

The following discussion splits the TSG recommendations which do not call for additional facilities into two overall categories: land use distribution and other travel management techniques which either gives incentives to the location of land to reduce the number and distance of trips or makes transit more competitive with single-occupant vehicles. **Table 2-2** examines the recommendations in terms of implementation obstacles, congestion reduction impacts, cost, and public acceptance. Implementation issues and future work concerning each recommendation are also discussed. Most of the recommendations are currently being pursued to some extent but current efforts appear insufficient for the long-term future of the County.

- **Land Use**

  As this report has already acknowledged, a fundamental aspect of transportation demand is the distribution and density of future land uses. Land use affects the distance of trips and the number of vehicular trips. At the risk of stating the obvious, the distance people travel is a function of the relationship between where they are and where they want to go. The closer home is to work, shopping, schools and recreation, the fewer total vehicle miles traveled as compared to the same amount of activity separated in space. Less space between the same amount of development means greater density. With sufficiently high density, what may have been vehicular trips often becomes walking trips. Transit is accessible to more people when densities are higher.

  Admittedly, density does create local congestion. However, having an alternative to that congestion (transit on an uncongested right-of-way) and minimizing the distance people travel in that congestion, can make for tolerable conditions even at high congestion levels. A focus on only roadway congestion levels, rather then the accessibility of an area, leads to recommendations that expand roadways and disadvantage pedestrians.

  On a regional basis, the existing policies of the jurisdictions in the Washington Metropolitan Region will create a future that is more spread out. In relative terms, as a job and housing center, the District of Columbia is becoming less significant. Given the concern for growth in vehicle miles driven per capita, the regional context cannot be ignored. Future growth plans for each jurisdiction collectively create an enormous need for transportation facilities. Whenever we look at transportation facilities on a regional basis, we should also look at land use distribution on the same basis. Competition, not cooperation, has been the hallmark of regional relationships in the quest for non-residential land uses. Each jurisdiction operates in what it perceives to be its own fiscal self interest which means an endless pursuit for tax ratables.

Table 2-2: An Examination of Recommendations by the Transportation Solutions Group

Recommendations	Implementation Obstacles	Transportation Demand Impact	Implementation Agency	Cost	Public Acceptance Obstacles	Implementation Issues	Future Work
Land Use Approaches							
1. Promote Smart Growth							
A. Ongoing Review of Land Use-Transportation Plan Consistency	Moderate	Significant Long-Term	Local and Regional	N/A	Varies with Location	• The impact of the economic incentives indicated below on current master plan smart growth recommendations could be significant.	• Produce "Smart Growth Plan Review Checklist" and "Smart Growth Master Plan Implementation Status Report." • Incorporate into the periodic production of the CBP master plan recommendations • Develop regional consensus
B. Economic Incentives							
• Variable impact fees/ property taxes	Significant	Long-Term	Local/State/ Regional	Unknown	Significant	• Significant state and local legislative/ public support issues. • Equity concerns. • Uncertain social, economic, and transportation impacts. • Involves major changes in housing market behavior. • Adoption by adjacent jurisdictions in region uncertain. • Regional suburban development patterns significantly established. • Private sector acceptance uncertain.	• Impact fees in County Council worksessions • Variable property taxes require study and state authorizations
• Split rate property taxes	Significant	Long-Term	State/Regional	Unknown	Significant	• Significant state and local legislative/ public support issues. • Equity concerns. • Uncertain social, economic, and transportation impacts. • Involves major changes in housing market behavior. • Adoption by adjacent jurisdictions in region uncertain. • Regional suburban development patterns significantly established.	• Conduct feasibility study including an in-depth analysis of social, economic, and transportation impacts required. • Select areas for application and develop tax schedule. • Review split rate property tax program in Pittsburgh.
• Location Efficient Mortgages (LEM)	Minor	Minor	State	None	None	• Private sector (banking) acceptance uncertain.	• Educate mortgage lenders
• Expand Live Near Your Work (LNYW) program through additional funding and aggressive tax credits	Minor	Minor	State	Minor	Minor	• Process in place	• Conduct an assessment of the state's current LNYW program. • Determine impacts of current program as well as criteria for where to expand it. • Designate new LNYW areas.
• Reduce size of priority funding on a regional basis	Moderate	Unknown	Regional	Unknown	Moderate	• Equity concerns • Compatibility with existing master plan recommendations uncertain	• Assess priority funding to date • Define more stringent criteria for establishing priority funding areas. • Relate to county master plans and recommendations.

Recommendations	Implementation Obstacles	Transportation Demand Impact	Implementation Agency	Cost	Public Acceptance Obstacles	Implementation Issues	Future Work
C. Design and Regulatory Techniques							
• Flexible street width standards and smaller setbacks in new developments	Moderate	Minor	Local	Minor	Minor	• Congestion reduction impact may be minor in the absence of a mix of land uses	• Continue to pursue street standards, bike/ped issues in DPWT facility planning efforts • Use GIS capabilities to identify deficiencies in pedestrian and bike system • Identify potential preservation areas in the County. • Obtain support and assistance from appropriate non-profit and charitable organizations in this effort.
• Enhanced pedestrian amenities in new and existing developments	Minor	Minor	Local	Moderate	Moderate		
• Use of grid street networks in new developments	Moderate	Moderate	Local	None	Moderate		
• Provision of additional funding for land assembly and preservation in protected areas	Significant	Moderate	State / Local	Significant	Moderate		
Travel Management Approaches							
2. Improve Competitiveness of Transit							
A. Provide better information, coordination, and integration of services						• Significantly higher ridership doubtful unless combined with other strategies involving land use, etc. • Cost of additional promotional campaigns may significantly exceed benefits. • Cost-effectiveness and cost accountability issues.	• Evaluate Ride-On and WMATA marketing campaigns. • Coordinate and use technology in providing transit information. • Examine cost/ benefit issues to determine validity of additional marketing /coordination strategies. • Review and evaluate bus/rail station operations (i.e. Friendship Heights) • Use GIS capabilities to identify deficiencies in pedestrian and bike system. • Review and evaluate the cost recovery ratios of other transit systems and evaluate performance. • Investigate new measures of effectiveness for transit service.
• Information improvements	Minor	Minor	Transit Providers	Moderate	None		
• Coordination and integration of services	Moderate	Minor	Transit Providers	Moderate	None		
B. Improve Accessibility and Service Quality							
• Improved sidewalks and bike path access	Minor	Minor	Local	Moderate	Minor		
• Patron amenities	Minor	Minor	Local	Moderate	None		
• Improved security	Minor	Minor	Local	Moderate	None		
• Improved bus travel times	Significant	Moderate	State / Local	Significant	None		
• Improvements to existing bus and rail services and facilities	Moderate	Moderate	Regional	Significant	Minor		
C. Revise Legislatively-Required Farebox Recovery Ratio	Significant	Moderate	State	Significant	Moderate		

Recommendations	Implementation Obstacles	Transportation Demand Impact	Implementation Agency	Cost	Public Acceptance Obstacles	Implementation Issues	Future Work
3. Adopt Innovative Transportation Pricing Techniques							
A. Parking cash-out	Moderate	Moderate	Regional	Minor	Moderate	• Significant state and local legislative/ public support issues concerning pricing. • Equity concerns. • Uncertain social, economic, and transportation impacts. • Adoption by adjacent jurisdictions in region uncertain • Zoning ordinance has parking reduction credits in CBDs and transit station development areas	• Determine regional prospects • Assess potential impacts
B. Distance-based auto insurance	Significant	Minor	Private	None	Unknown		
C. Parking pricing	Moderate	Potentially significant	Regional	Minor	Moderate		
D. Other vehicle travel-based charges	Significant	Potentially significant	Regional	Significant	Significant		
E. Value pricing on major highway facilities	Significant	Significant	Regional	Significant	Significant		
4. Manage infrastructure more efficiently and encourage intermodal tripmaking through greater use of ITS technology solutions							
A. Use cellphones, video, and other detection technologies to monitor roads and transit operations.	Moderate	Minor	Regional	Moderate	Minor	• Ongoing M-NCPPC project to develop software to extract traffic volume data from ATMS for planning activities and travel demand modeling. • Numerous high tech companies and government agencies in metro area may provide excellent environment for telecommuting (including part-time). • Potential win/win situation for employers and employees. • Investigate travel demand reduction potential.	• Coordinate MD and VA ITS information distribution on Internet web pages. • Incorporate ITS recommendations in developing master plans. • Evaluate need to provide real-time parking lot vacancy information and real-time speed information to the public. • Investigate evolving state government telecommuting program and established federal government program. • Examine private sector participation and technology-related developments.
B. Apply a broad range of controls that maximize efficiency of expressways and arterials such as traffic responsive signals, speed control signs, ramp meters, and other control features.	Moderate	Moderate	Regional	Significant	Minor		
C. Organize immediate and coordinated responses to vehicle breakdowns or accidents with emergency equipment to minimize delay and improve safety.	Minor	Moderate	Regional	Moderate	None		
D. Use a broader range of communication tools such as special radio stations, electronic message signs, and the Internet to inform the traveling public about current and predicted travel conditions and viable route and mode options.	Minor	Minor	Regional	Moderate	None		

Recommendations	Implementation Obstacles	Transportation Demand Impact	Implementation Agency	Cost	Public Acceptance Obstacles	Implementation Issues	Future Work
E. Provide new traveler services such as "Mayday" systems to automatically notify emergency response entities of problems, in-vehicle navigation systems to provide alternative routing advice, and the use of smart card travel passes which provide travelers simple access to all modes and providers of transit service.	Significant	Moderate	Regional	Significant	Minor		
F. Establish protocol and authority to act expeditiously on identified problems.	Moderate	Minor	Regional	Minor	Minor		
G. Endorse the concept of telecommuting.	Moderate	Moderate	Regional	Moderate	Minor		

This will not change unless the method of tax collection is changed to alter existing cost benefit equations.

The Montgomery County General Plan envisioned transit serviceable densities. The Transportation Solutions Group pointed out that we have not been achieving that goal as well as we might. It is the General Plan vision that is our collective goal. Transportation should be the servant of that envisioned land use. With every master plan, we review the balance between land use and transportation.

We need to focus master plans on reducing vehicle miles of travel per capita and creating walkable and bikeable environments where the automobile is not the only transportation choice.

The decision of individuals to locate jobs or housing involves economic and social factors. Some of those factors are in government's control. Successfully affecting land use decisions will involve looking at those factors which can be controlled by government and offering incentives that match our vision. Many of the TSG's recommendations lean toward changing the policies that affect the location decisions of individuals. The TSG neglected the role of perceived safety and public school quality have on choosing a location to live or work.

Every investment the government makes in both capital and operating expenses can be promoting smart growth or sprawl and should be viewed in that context.

Master plans and zoning do not put buildings on the ground. It is the private sector that determines when and where capital should be committed to development. The existing policies of the County, combined with existing market conditions, have been somewhat successful at getting the private sector to locate new jobs at existing or planned transit stations. Outside of Central Business Districts, however, the density of this development is less than what was envisioned. We still have a suburban mentality about density. Our zoning ordinance and subdivision regulations do not approach land near transit stations as a finite resource. One example of this is that the County does not have a minimum density provision around transit stations. The challenge is to do this in such a way that employers have incentives to match our land-use vision.

Getting housing units near transit stations has proved even more challenging. Given that the County has more than 300,000 dwelling units, there are more than 300,000 different reasons why people choose to locate where they do. Each one is rational from the point of view of the decision maker. Commuting time is weighed against housing costs. Housing costs are a manifestation of the accessibility of the house to desired land uses, public school quality, safety concerns and housing quality, to name just a few factors. If we are to be more successful, public policy must change this equation in a manner that attracts

housing to the vision of the General Plan. The policies which may have beneficial results follow.

- **Other Specific Transportation Management Solutions**

Economic Incentives

Beyond traditional zoning, the TSG recommended that the government influence land use locations by changes to impact fees, property taxes, mortgage regulations, direct incentives for people to live near work, and the size of state-required priority funding areas. This policy package is geared toward directing growth to areas best served by existing and planned transportation facilities. Impact fees are an issue currently before the County Council. Creative tax policy changes may require state legislative action. Similar programs around the country, if available, should be reviewed before proceeding. The strategies involving taxes, mortgage programs, and pricing may provide significant long-term improvements in the performance of the region's transportation system, particularly when combined with other approaches. These strategies require further attention, however, to understand the social, economic, and transportation impacts surrounding their implementation. Research concerning these strategies will take time and should be conducted as soon as possible.

Changes to mortgage lending criteria based upon a reduced need for car ownership will produce marginal benefits at best. It can be brought about by educating lenders without the need for legislative action. An increased direct incentive program for people to live near their place of work is worthy of additional investigation. The TSG noted that placing more restrictions on the geographic area permitted to be smart growth area is best done on a regional basis. To do so unilaterally could have the unintended consequence of just pushing growth further from the regional core.

Designing for Pedestrians and Bikes

Policy changes such as flexible street widths, forcing building close to the street, improving sidewalks and bike paths are aimed at making walking convenient and enjoyable and getting to transit without a car. To the extent of our regulatory authority, this is something the Planning Board already focuses on in the subdivision and site plan process. Past efforts to require more development to have site plan review have not been successful. Our subdivision requirements for non-site plan development can also be reviewed to determine if they are producing desired results.

Increasing the Competitive Advantage of Transit

Improving transit service, transit information, security, integration between modes, reducing transit pricing, and requiring the same private-employer subsides for transit riders as for car drivers (parking cash-out) are measures to increase the competitive advantages of transit and induce more transit ridership. Reducing the price of transit has a proven effect on ridership. This is a costly option but worthy of further investigation. Transit agencies are already in the process of trying to make it easy to switch between systems and these efforts should continue. Better communication between the transit providers and their customers increases the convenience of transit service. Real time information on the next bus approach will be technologically possible shortly. In the mean time, clear maps with routes and schedules should be made more readily available. Employer subsidies for transit riders are best pursued through Transportation Management Organizations.

Increasing the Cost of Automobile Use

Another group of policies under the heading of innovative transportation pricing techniques increase the relative advantage of transit by making driving cars more expensive. These policies include distance-based auto insurance, parking pricing, vehicle travel-based charges (tolls or other milage charges) and "value" pricing highway facilities (tolls that go up in price with congestion). These are the only direct disincentives recommended by the TSG. If parking charges, taxes, or pricing are rigorously applied in only one jurisdiction, market competition will promote a shift in resources to other areas of the region. Unless the County desires to slow its rate of growth, these polices should not be pursued unilaterally with the possible exception of parking pricing policies in County-owned facilities. Enhancing cooperation and coordination between jurisdictions is extremely important in addressing economic and transportation issues. This will be challenging given the two states, the District of Columbia, and the various counties and municipalities that comprise the region.

Increasing Efficiency of Existing Infrastructure

The Intelligent Transportation System (ITS) recommendations included in the report should continue to be a high priority in making our existing transportation system more efficient and its users more knowledgeable. Greater regional coordination and cooperation among VDOT, MDOT, and D.C. should be aggressively pursued. Greater consolidation of real-time information distribution from ITS technologies is already occurring. For example, all ITS traffic monitoring outputs from the various jurisdictions could soon be available at one internet site. The implementation of the various surveillance, traffic control, and communication-related recommendations should be regionally coordinated to improve traffic operations.

Another technology-related strategy endorsed in the report that warrants further discussion is telecommuting. This strategy seems particularly attractive for the Washington metropolitan area given its economy, work force, and infrastructure. It offers a great deal of flexibility for full-time or part-time implementation.

The economy in this area is generally driven by the federal government, related government-supporting businesses (defense, research, legal, etc.), high technology firms, and telecommunication companies. Many workers are involved in the creation, processing, exchange, and management of information. The area is a focal point for internet traffic. The culture of the workplace is becoming more flexible in this era of rapid technological change.

Much of the work force is affluent and well-educated. The "work at home" phenomenon is becoming more viable for businesses because homes can be directly connected to the work site via computer and telecommunications. The ability to work at home is attractive to many households given time constraints, expenses such as daycare, and widespread computer ownership.

With regard to infrastructure when considering telecommuting, it may be helpful to compare our on-ground transportation system to the cable/wireless systems used to communicate and transfer data. The capacity of our transportation system is increased very slowly through great expense and often public opposition, and lags far behind explosive residential and commercial growth. Vehicle travel speeds continue to decrease. However, the capacity in our cable and wireless communications systems continues to expand significantly through technological advancements; the speed of information traveling through them continues to accelerate. These rapidly expanding systems are prevalent in the Washington area. Telecommuting helps people "get to work" using systems where capacity is available.

Obviously, telecommuting may not work for various companies given the nature of their business. Off-site employee work performance and monitoring as well as business productivity may be issues for others. But given our economy, work force, and high technology infrastructure combined with the severity of our traffic congestion, telecommuting will continue to offer a practical, efficient, alternative way to conduct business.

Currently, the federal government is implementing telecommuting in various agencies and funding telecommuting centers at suburban locations. The State of Maryland will be initiating telecommuting policies for its workers shortly. Any policy that promotes four-day work weeks for a significant number of employees, whether it is by virtue of telecommuting one day a week or extending hours in the four days of work, can cause significant reductions in commuter travel

7. Next Steps in Studies and Planning

A topic such as the most appropriate transportation system for the 20- and 50-year time frame is one that should include on-going discussions around an agreed-upon basic network. It is hoped that the network resulting from the discussions beginning with the recommendations in this plan will form a plan for the upcoming regional CLRP and subsequent funding decisions. However, new ideas will continue to be raised, and additional studies can provide valuable information. Staff is aware that additional work is needed on some aspects of the recommendations now, as well as topics that have recently arisen. The following would be valuable for additional analysis as resources permit.

- **Operating cost analysis for the rail and bus systems identified in this report.** Operating costs are not as amenable to estimating as capital costs, and staff was not able to perform these within the time available for this study. Outside agencies familiar with bus and rail operations would be valuable in this regard.

- **Completion of the I-270 Corridor Local Network Analysis, now underway by the Park and Planning Department staff.** This study focuses on the roadway links and intersections in the I-270 corridor, from North Bethesda to Clarksburg. It will provide more details on the balance of land use and transportation in this area, and help in prioritizing intersection and roadway improvements identified in this the 20-year plan. This work has been delayed due to the need to focus resources on the TPR, and results will not be available for discussion until late Fall of 1999.

- **Continued analysis and discussion of the potential to make significant changes to the location and density of development around current and even additional Metrorail and light rail stations.** The work on the TPR shows that current trends, especially for housing, are not transit oriented, and that changes to plans, and probably policies, would be needed to amend this situation over time.

- **Completion of the TPR work scope calling for staff analysis of potential County policies and actions that would support the 20-year network plans.** This would include many of the actions identified in the Transportation Solutions Group Report, or which arise out of the discussions concerning the recommendations in the TPR.

- **Analyzing Year 2025 forecasts to determine additional facility needs.** At the start of this report, 2025 forecasts were unavailable. It is MWCOG's intent to stretch the CLRP to 2025 in the upcoming cycle and County recommendations must be consistent with this time frame.

Chapter III: Study Process

The TPR used a combination of analytic and consensus building techniques to develop recommendations for transportation network programming, transportation policy and, ultimately, for land use planning. The consensus building process, involving interagency coordination and citizen involvement, was described in **Chapter I.** This chapter describes the quantitative travel demand forecasting, environmental and community evaluation, and capital cost estimating techniques applied during the development process.

Because of the complexity of describing both the networks and the evaluation process, they have been separated. This Chapter focuses on the process of developing the Recommended Year 2020 Network. **Chapter IV** describes the results of the evaluation of the Combination Alternatives and the Recommended Year 2020 Network.

The purpose of the Transportation Policy Report is to develop recommendations for the future transportation system in Montgomery County. A transportation system consists of three primary elements:

- Land use patterns
- Transportation infrastructure and services
- Transportation policy

The TPR includes recommendations for two time horizons:

- Short-term (Year 2005)
- Medium-term (Year 2020)

It also provides insights to a much longer time horizon of Year 2050.

- Long-term (Year 2050)

Travel demand analyses were performed to assess the performance of alternatives for the Year 2020 and Year 2050. Recommendations for the year 2005 were developed using a qualitative prioritization of the Year 2020 recommendations. The focus of the study approach is therefore on the Year 2020 and Year 2050 analyses.

This chapter describes the study process. First, an overview of the analytic approach is provided, followed by a discussion of the Year 2020 and Year 2050 analysis procedures. The results of the analysis are presented in **Chapter IV**.

1. Analytic Approach

The purpose of the analytic approach is to develop quantitative measures of effectiveness which can be used to differentiate between alternative courses of action to determine which

course best achieves the County's transportation system goals. The analytic approach relies heavily on the evaluation of travel demand and transportation system performance.

- **Goals, Objectives and Measures of Effectiveness**

  The recommendations of the TPR are designed to achieve six study goals described below. For each goal, the objectives and measures of effectiveness have been used to evaluate the degree to which alternative transportation networks, land use plans, and policy changes achieve the goals.

  The evaluation of quantitative measures of effectiveness allows two types of comparisons to be made. First, the relative value of a given land use, network, or policy proposal can be assessed by comparing the results of that proposal against the results of the "no-build" condition for the same horizon year (such as comparing the Year 2020 Recommended Network against the Year 2020 Base (CLRP) Network. Second, the absolute change in travel conditions can be assessed by comparing the results of future year alternatives against current conditions (such as comparing the Year 2020 Recommended Network against the 1998 Base

  The evaluation of goals and objectives is ultimately a subjective one. The study goals are often diametrically opposed, or generally in conflict with each other. For instance, improving mobility and accessibility without adversely affecting the environment usually requires substantial capital cost, which may not be an optimal use of scarce public resources. While nearly all the project objectives can be measured quantitatively, the relative value of achieving one goal at the expense of another is generally a personal decision. *This report, therefore, does not use any single evaluation criteria to balance the costs and benefits of each transportation project or alternative.*

  Enhancing mobility is evaluated by reviewing change in transit boardings, amounts of vehicle travel, and levels of congestion. The objective of the TPR is to reduce both travel times and levels of congestion.

  Increasing accessibility is evaluated by reviewing the change in both travel opportunities and desirable destinations available to those who live or work within Montgomery County. The objective of the TPR is to increase travel opportunities. Three measures of effectiveness are used to evaluate this objective.

  The **first measure of accessibility** is the proximity of County businesses and residences to fixed-guideway transit service. A presumption of the TPR is that all geographic areas of the County are physically served by public roads and streets. Not all areas, however, are served by transit within walking distance. Increasing the geographic coverage of transit service accomplishes two objectives. First, transit provides a means of travel for those who either do not have access to an auto or consider the costs of auto use, such as insurance rates or parking charges,

to be prohibitive for daily use. Second, transit services which operate on independent alignments (such as commuter rail, Metrorail, or even Smart Mover buses on the Capital Beltway shoulder) can provide a time-savings alternative means of travel in congested corridors.

The **second measure of accessibility** is the change in the number of destinations which can be reached within a fixed travel time. The realtor's mantra of "location, location, location" is based in part on the fact that the value of a property is a function of how well connected it is to desirable activity centers. Thus, the utility of a business or residence can be increased by increasing the number of travel destinations available within a reasonable travel time. For instance, a home with three grocery stores within five minutes is considered to have greater accessibility than a home with only a single grocery store within five minutes.

This measure of accessibility is evaluated by identifying the number of job opportunities which can be reached within 45 minutes from Montgomery County households and the number of homes which can be reached within 45 minutes from Montgomery County employment locations. The accessibility of a location can be improved by either clustering land use so that more jobs and households are proximate to each other, or by improving transportation systems so that more geographically distant opportunities can be reached.

The third measure of accessibility is average travel times. This is the time it takes for the average auto and transit trip between both jobs and households in the evening peak hour. The TPR objective is to reduce travel times, especially for transit trips.

Reducing negative impacts on the environment is evaluated by considering both the adverse effects of constructing new transportation infrastructure and the environmental cost of automobile travel. In this case, the TPR objective is the same as the goal: reducing negative impacts on both the natural environment and adjacent communities.

The adverse effects of construction are considered qualitatively in the evaluation of individual projects. From a sketch-level perspective, mitigation of adverse impacts is also incorporated into project capital cost estimates.

Vehicular travel generates adverse environmental impacts, both from the perspective of the effect of emissions on air and water quality as well as from the perspective of using potentially scarce energy sources. The change in total daily vehicle miles of travel is used to assess the environmental effect.

Supporting orderly growth is evaluated by the degree to which the level of forecast economic development at key locations can be accommodated with a satisfactory level of transportation network performance.

Supporting and enhancing future communities is the goal of having a transportation system that fits well with County land-use plans. This is evaluated by qualitatively considering how consistent the different networks are with County area master plans. Although plans can be and are changed, to reflect new situations, networks that are consistent are more likely to fit with current land-use planning than others which are not consistent. The other measure for this goal is how well the alternatives provide the transportation services that will support the desired patterns in the County plans.

Optimizing public investment is evaluated by reviewing both capital cost estimates and effectiveness estimates. The TPR objectives are to develop an affordable set of recommended improvements and ensure that those improvements are well used. Capital cost estimates, travel demand estimates, and transit patronage forecasts are all used to evaluate the return on public investment.

- **Horizon Years**

The primary focus of the TPR is on the medium-term (Year 2020) horizon. In order for transportation projects in Montgomery County to be eligible for federal funding, they must be included in the region's CLRP and that plan must have demonstrated conformity to governing air quality legislation. The CLRP was most recently updated in 1998 and will be revised again in 2000. This TPR contains staff recommendations for changes to the CLRP.

The first step in implementing the projects in the CLRP is prioritization and funding allocation as part of the State of Maryland's Consolidated Transportation Program (CTP). The CTP, updated annually, therefore represents priorities of the CLRP. The TPR also contains staff recommendations for the FY 2000-2005 CTP.

The TPR recommendations for the short-term and Year 2020 focus primarily on infrastructure and services for two reasons. First, a fixed budgeting cycle exists for infrastructure and service improvements, via the CTP and the CLRP, whereas land use and policy decisions are not made within a predetermined timetable. Second, the benefits of infrastructure and service changes can often be realized immediately upon implementation. Project implementation can occur within a relatively short time frame, such as perhaps a year for minor improvements or a decade for major design projects requiring significant environmental review.

Most of the land use policy changes evaluated in this report, however, will not yield anticipated benefits until they have been in place for several decades. Therefore, the evaluation of the long-term future of Montgomery County focuses

on the effect of alternative land use scenarios on the master planned transportation system.

Transportation policy changes will be considered for both medium-term and long-term horizons. The results of the policy evaluations and policy recommendations will be included in the final version of the TPR.

In summary, the analysis of Year 2020 and Year 2050 alternatives serve independent purposes. The Year 2020 analyses were performed to identify transportation network recommendations. The Year 2050 analyses were performed to identify recommendations regarding land-use patterns. The procedures and chronology of the Year 2020 and Year 2050 travel demand modeling and alternatives evaluation are therefore discussed in separate sections below.

- **Travel Demand Model**

Regional transportation models are generally structured to analyze the flow of trips of people and/or vehicles over highways and/or transit networks throughout a specified geographical area. These tools are used to forecast and evaluate the travel demand implications of various land use/transportation scenarios. This study employed the use of the Department's TRAVEL/2 transportation model as a key analytical tool to support the travel demand evaluation of the various future network alternatives under consideration. The TRAVEL/2 model is **designed to forecast evening peak-hour vehicle travel demand**, given a set of inputs detailing the land use patterns, demographic information, and transportation network facilities. For transit use, the broader three-hour evening peak period (3:30 - 6:30) is used. A fuller discussion of the TRAVEL/2 model is provided in Appendix C of this Report.

2. Year 2020 Analyses

The Year 2020 analysis supporting the TPR recommendations is divided into six phases:

- Introductory Studies
- Alignment Alternative Evaluation
- Mode-Specific Alternative Evaluation
- Combination Alterative Evaluation
- Recommended Year 2020 Network
- Supporting Policy Evaluation

This document presents the results of the first five phases. Evaluation of the final phase, supporting policies, will be conducted after review of the materials in this Staff Draft report and will be incorporated into a subsequent report later in 1999.

- **Introductory Studies**

  The introductory studies focused on three topics which set the context for the TPR in terms of travel behavior and current transportation policy:

  - The Status of the Six Major Transportation Studies (6-12-97)
  - Round 5.4 Forecast for Montgomery County (6-19-97)
  - Commuting Patterns - 1990 and 2020 (4-2-98)

  Staff presented these studies to the Montgomery County Planning Board at three worksessions on the dates listed above.

  The primary finding of this review was that the corridors being analyzed in the six major transportation studies did encompass the most pressing travel needs forecast for Montgomery County. In other words, subsequent phases of the study did not need to add new transportation corridors, but rather focus on prioritizing the recommendations for the six major study corridors, and how these could be combined into effective networks.

- **Alignment Alternative Evaluation**

  The purpose of the alignment alternative evaluation was to reduce the number of alternatives to be evaluated in subsequent phases. From the six major transportation studies, thirteen network components were developed for the evaluation. These components included eleven initial transitway alignments, as shown in **Figure 3-1.** The twelfth network component consists of area-wide highway and HOV improvements, generally based on the Montgomery County Council's *Priorities for State Transportation Projects, Programs, and Studies,* issued in June 1998. The thirteenth component is provision of general purpose travel on a new roadway link between I-270 and Georgia Avenue/Layhill Road (already included as Transitway Alignment #2).

  Networks of rail transit, busways, and roads were developed in such a way that, by comparing the performance of selected pairs of networks, the benefits of the alternative alignments could be identified. **Table 3-1** defines the thirteen components and shows how they were combined into eleven network alternatives, labeled A through K.

Figure 3-1

PRIORITY FUNDING AREAS AND THE TEN INITIAL ALIGNMENTS

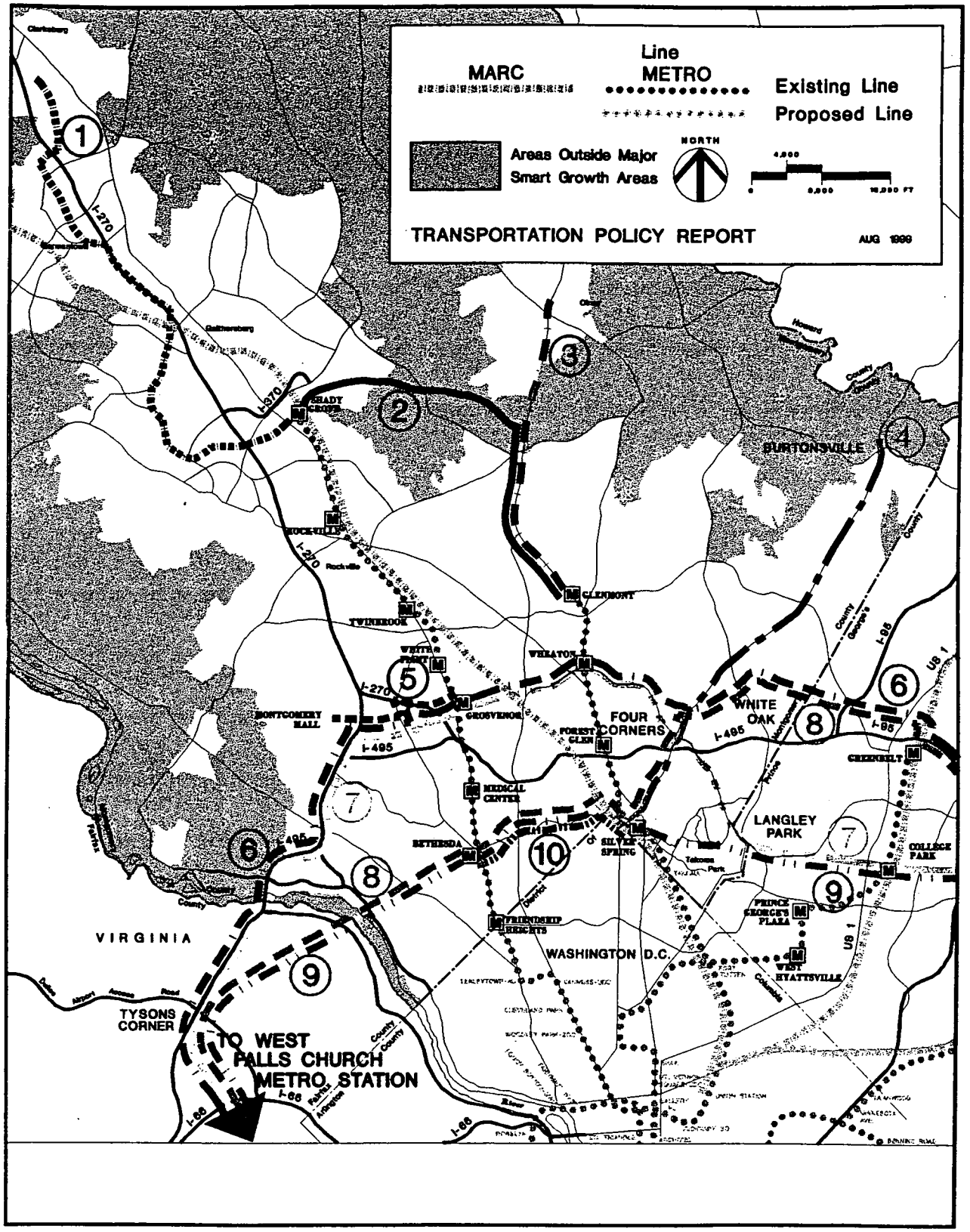


Table 3-1: Alignment Alternative Networks

NETWORK COMPONENTS	BASE CASE	ALTERNATIVES										
		A	B	C	D	E	D	G	H	I	J	K
1. Corridor Cities Transitway	-	X	X	X	X	-	-	X	X	X	X	X
2. Metro Line Connector	-	X	X	X	X	-	X	X	X	X	X	
3. Georgia Avenue Busway	-	X	X	X	X	X	X	X	X	X	X	
4. US 29 Transitway	-	X	X	X	X	X	X	-	X	X	X	
5. North Bethesda Transitway	-	-	-	X	X	-	-	-	-	-	-	-
6. Beltway Outer Transitway	-	X	-	-	-	X	X	X	X	X	X	
7. Beltway Combination Transitway-University	-	-	X	-	-	-	-	-	-	-	-	-
8. Beltway Combination Transitway - US 29	-	-	-	X	-	-	-	-	-	-	-	-
9. Beltway Inner Transitway	-	-	-	-	X	-	-	-	-	X	X	
10. Georgetown Branch Transitway	-	X	X	-	-	X	X	X	X	X	X	
11. I-270 Premium Bus	-	-	-	-	-	X	X	-	-	-	-	-
12. Highway and HOV Improvements	-	X	X	X	X	X	X	X	-	X	X	
13. Road between I-270 and Georgia Avenue/ Layhill Road	-	-	-	-	-	-	-	-	-	-	X	

Comparisons were also made in comparison with the Year 2020 base condition. The Year 2020 base, or "No Build" network includes the existing transportation facilities and services as well as those in the current CLRP, with the exception of the Georgetown Branch Trolley. The Georgetown Branch Trolley is one of the facilities being evaluated. Therefore, the results are more intuitively understood if the Georgetown Branch alignment is removed from the Base Network than if its effects are documented by removing it from one or more of the alternatives.

The alignment alternative evaluation process yielded two primary findings which were used to develop mode-specific alternatives:

- As the smallest travel network, the Montgomery County Council alternative (Alternative K) provides substantially less accessibility than any of the other ten alternatives evaluated. It was also the least effective alternative at reducing county-wide transit travel times.

- Two alignments were found to provide less of an improvement in accessibility and mobility than the other circumferential alignments from the Capital Beltway Study. These alignments are the combination alignments -- Alignments #7 and #8 in this analysis. They include portions both inside and outside the Beltway with connections on University Boulevard (Alignment #7) and US 29 (Alignment #8). Although these connecting portions of the

alignments are high-volume bus transit corridors, the alignments as a whole do not appear to improve accessibility and mobility sufficiently to warrant their further consideration. Therefore, they were removed from the study. Portions of the alignments which are well used were incorporated into a modification of Alignment #9.

- **Mode-Specific Alternative Evaluation**

The mode-specific alternative evaluation was conducted to examine the different travel markets served by each mode. The purpose of this evaluation was to determine which modes, if any, had the greatest effects on county-wide measures of effectiveness.

The alignment alternative evaluation demonstrated that significant travel demand exists in all but one of the alignments examined. Even in a single corridor, however, alternative alignments tend to serve slightly different markets. The market served is generally a function of the alignment mode and specific location. Heavy rail service tends to serve only the most dense development activity centers and, if located below grade, provides excellent service with limited environmental impact. Light rail and busway alignments can more easily be designed to serve a larger number of less densely developed activity centers, but with a less efficient line-haul service due to the increased number of stations. Express bus and HOV along existing corridors such as I-270 and I-495 provide the greatest flexibility in serving disparate desire lines via through-routing, but tend to bypass activity centers rather than provide direct access.

Four mode-specific networks were evaluated:

- Heavy rail transit network
- Light rail transit network
- Busway and HOV network
- Roadway network

The mode-specific alternative evaluation process yielded four primary findings which were used to develop combination alternatives:

- The heavy rail transit mode does not provide significant advantages in comparison to comparable light rail services to warrant its additional cost and environmental/community impacts. Heavy rail was therefore removed from further consideration.

- The circumferential rail alignments did not demonstrate sufficient travel demand across the Potomac River toward Tysons Corner to suggest that they would be cost-effective in the Year 2020. Fixed-guideway service from Montgomery County to Fairfax County was therefore removed from further consideration.

- Even with transit service on the Corridor Cities Transitway and Express Bus service on the HOV lanes of I-270, both services showed strong ridership, indicating that there are different travel markets to be served.

- The Georgia Avenue Busway showed strong volumes.

- **Combination Alternative Evaluation**

Staff developed four combination alternatives with the assistance of the Consultant Team, the Technical Work Group and the Project Advisory Team. The combination networks were developed to meet the following objectives.

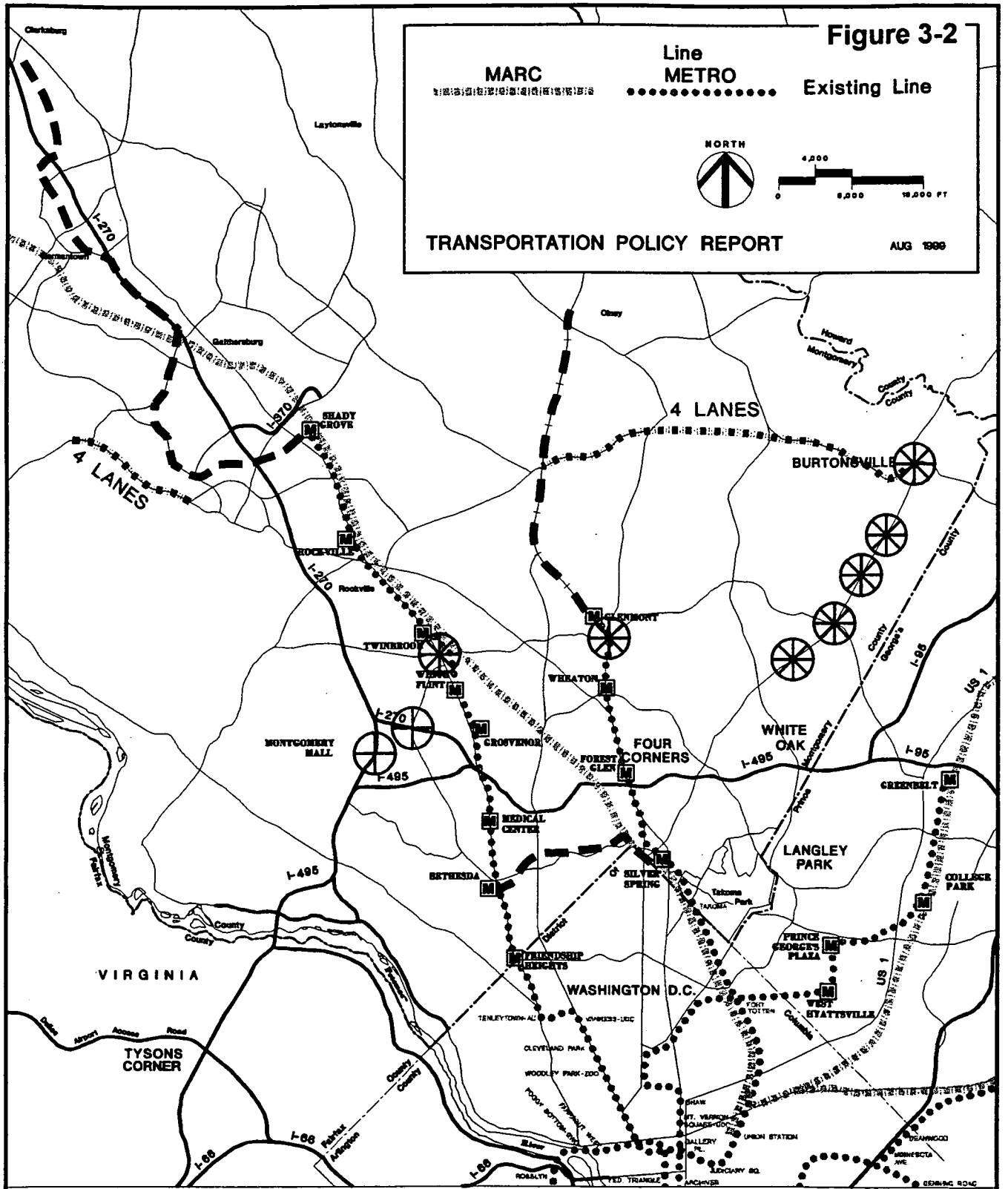
- Demonstrate the comparative benefits of increasing total investment levels
- Serve both activity centers and other County-wide travel needs
- Serve both radial and circumferential travel
- Incorporate each of the thirteen network components in at least one combination network

The combination networks, shown in **Figures 3-2** through **3-5**, are summarized below, in order of increasing complexity:

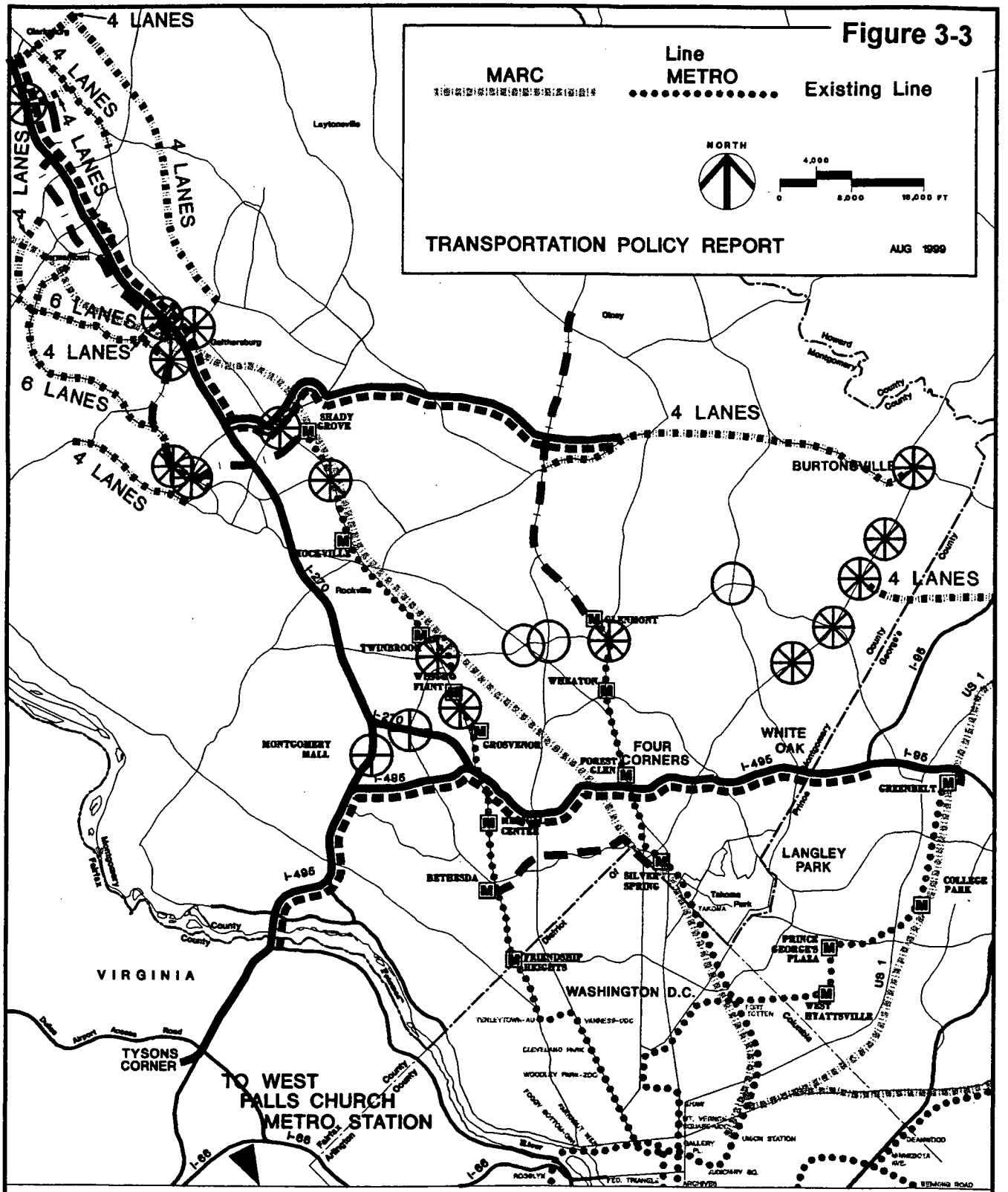
The **Montgomery County Council** Network, abbreviated as **Combination Network A**, includes the projects recommended by the County Council in June, 1998, expanded with an extension of the Corridor Cities light rail line from Germantown to Clarksburg. The Montgomery County Council network also serves as a base from which to build the other combination networks.

The **Mixed Mode** Network, abbreviated as **Combination Network B**, expands the Montgomery County Council network with a focus on County-wide busway and HOV improvements. The network includes the completion of HOV lanes on I-270 and the addition of HOV lanes on I-495. Now, four-lane roads connecting I-370 and Georgia Avenue and connecting US 29 and US 1 are also included. Express bus service is provided along I-495, on I-270 north of Shady Grove, on the new road connecting I-370 to Georgia Avenue or Layhill Road, and on the Georgia Avenue Busway. Additional roadway network enhancements are included in Germantown and Clarksburg. The only change to the Montgomery County Council projects is a modal change from light rail to bus on the Corridor Cities alignment.

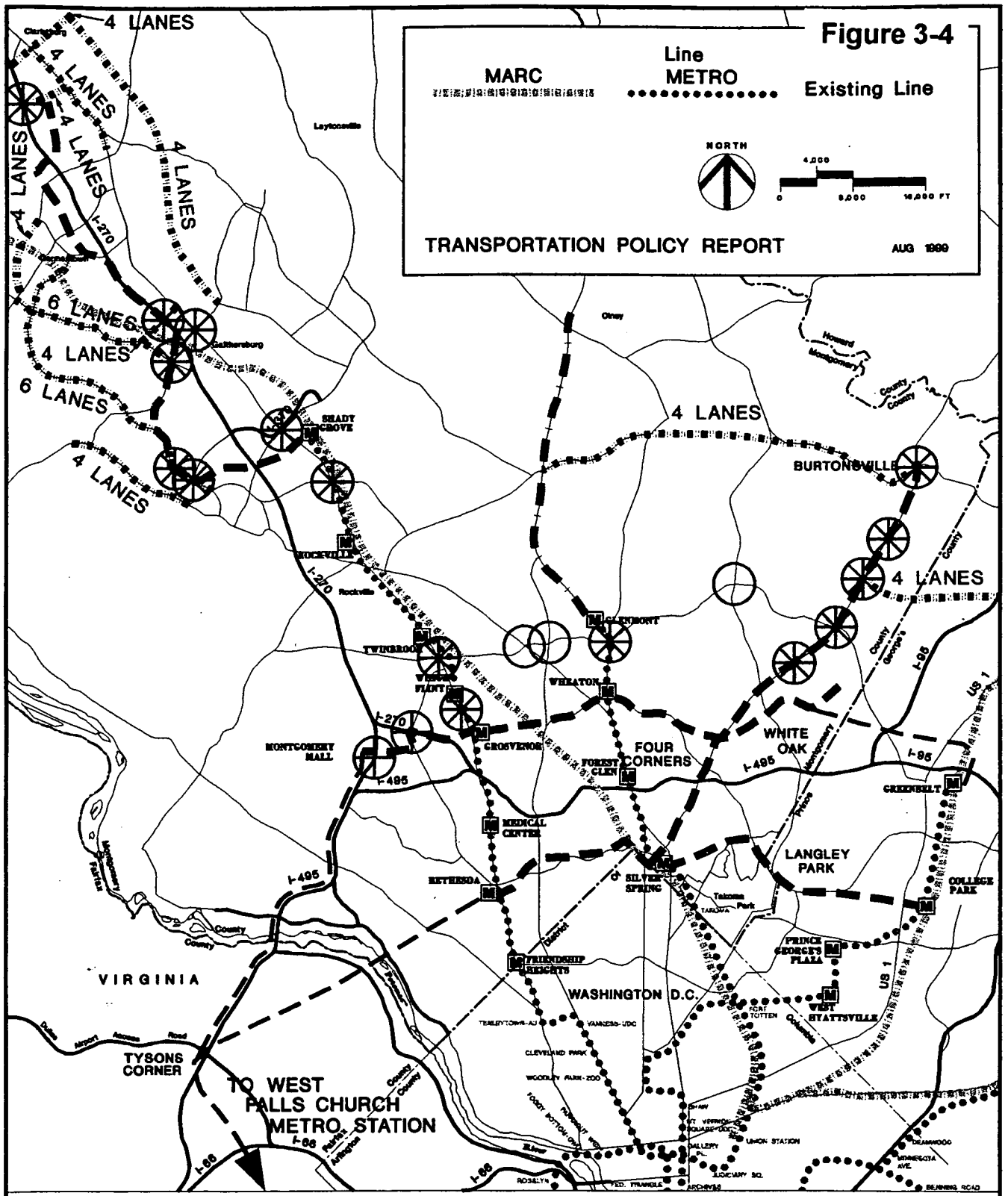
COMBINATION NETWORK A: MONTGOMERY COUNTY COUNCIL



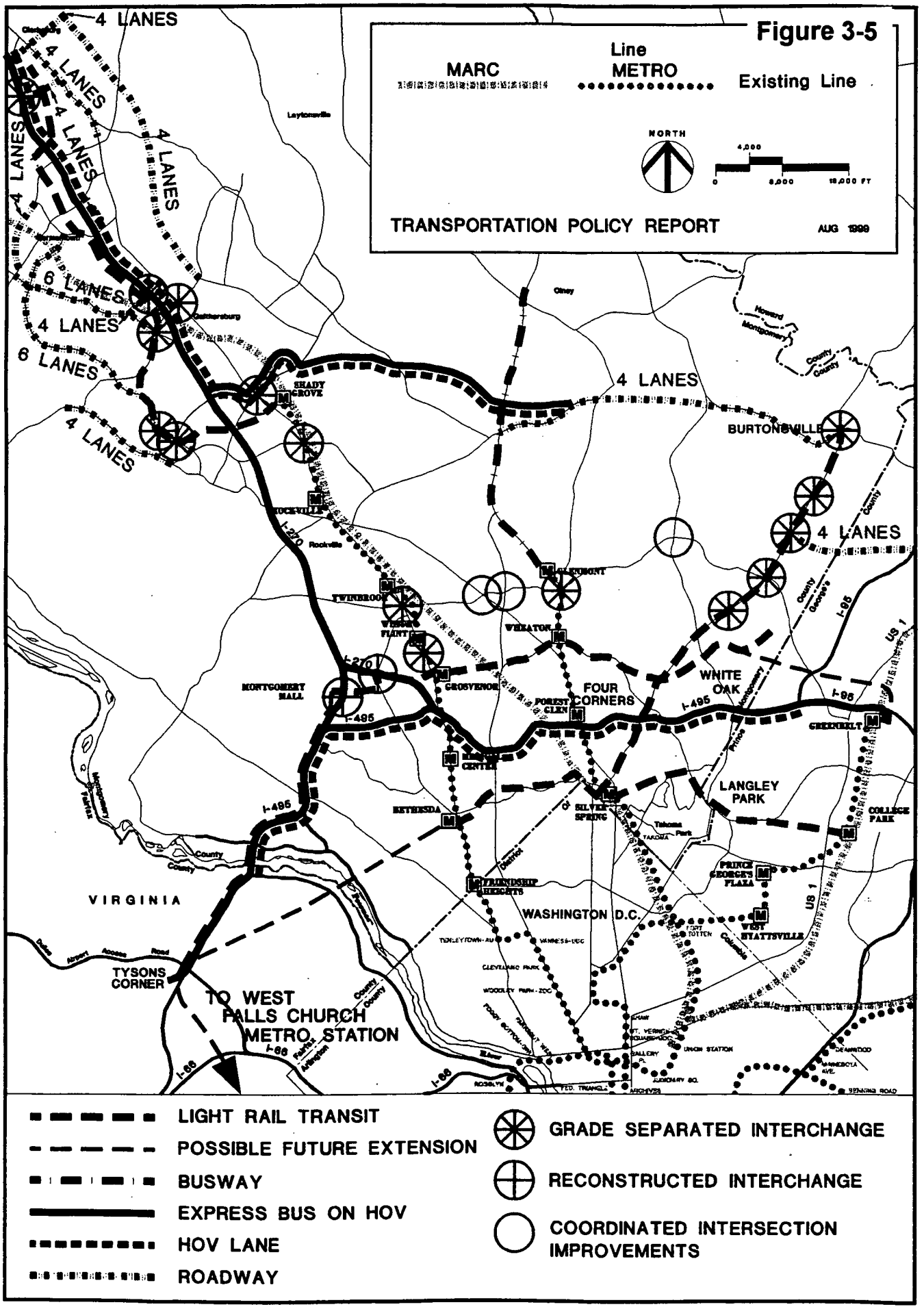
COMBINATION NETWORK B: MIXED MODE



COMBINATION NETWORK C: LIGHT RAIL EMPHASIS



COMBINATION NETWORK D: MAX BUILD



The widening of Norbeck Road Extended (MD 28 and MD 198 between Georgia and US 29) on the County Council's Priority List, is consistent with the area master plans; two lanes are scheduled for construction. The new roadway between I-370 and Georgia Avenue or Layhill Road is also on the area master plans. Staff recognizes the potential environmental issues of constructing this new roadway and the community concerns regarding connecting these two master planned roadways. These issues should be addressed as part of future project planning.

The **Light Rail Emphasis** Network, abbreviated as **Combination Network C**, expands on the Montgomery County Council network with a focus on down-County circumferential rail service. Two circumferential light rail transit lines are provided, one connecting Montgomery Mall to White Oak via Grosvenor and Wheaton, the second connecting Bethesda to College Park via Silver Spring. Light rail service is also provided in the US 29 corridor, connecting Silver Spring to Burtonsville. Express bus service is provided on the Georgia Avenue busway. Additional roadway network enhancements are included in Germantown and Clarksburg.

The **Max Build** Network, abbreviated as **Combination Network D**, incorporates all of the improvements identified as part of Networks A, B, and C. This network is used to demonstrate the effectiveness of "doing it all". It is impractical to suggest that this Max Build Network could be fully implemented by the Year 2020 unless substantial national and regional policy changes regarding resource allocation and the environmental review process were implemented. This network, therefore, demonstrates potential benefits of additional transportation infrastructure beyond that recommended for the CLRP and may provide some guidance for long-range planning beyond 2020.

The combination alternative evaluation process yielded three primary findings which were used to develop the recommended Year 2020 network:

- The eastern end of the "inner purple line", connecting Silver Spring to Greenbelt, has marginal utility because it provides only a slight improvement over the CLRP network connection between the two stations via a transfer at the Fort Totten Metrorail station.

- East-west transit travel demand between the radial transit and HOV corridors (I-270, MARC/CSX, Georgia Avenue, and US 29) tends to consist of radial travel shifting from one radial corridor to another, rather than circumferential travel between activity centers. A result of this pattern is that the circumferential transitways evaluated demonstrated the highest line-specific ridership between the two branches of the Metrorail Red Line. The Georgetown Branch light rail line is included in the recommended 2020 network because both its terminals are concentrated employment centers with sufficient density to attract rail commuters. Rail transit between Grosvenor,

Wheaton, and White Oak is not included in the 2020 Network because the densities for these centers, as currently planned, will not attract sufficient numbers of rail commuters. Should the master plans for these communities outside the Capital Beltway be revised to specify higher concentrations of transit-oriented development, the "outer purple line" may become feasible. Such a land use change, however, cannot be effective within the time frame of the next CLRP.

- Express transit service in the US 29 corridor between the Silver Spring Metrorail station and White Oak and Burtonsville is not expected to be cost-effective within the next twenty years due to a combination of operational characteristics and engineering constraints. Programmed interchange improvements in this portion of US 29 will convert the facility to a six-lane freeway, with access permitted only at interchanges. Travel demand on this portion of US 29 will be somewhat constrained by limited capacity crossing the Patuxent River to the north and Four Corners to the south. To the north of White Oak, therefore, no appreciable transit travel time savings would be accrued by implementing a transitway. To the south of White Oak, development of a transitway would have considerable capital cost and community impacts.

- **Recommended Year 2020 Network**

  The results of the analyses of the Year 2020 Combination Alternatives were prioritized to develop the recommendations for the Year 2020 network described in the CLRP Section of Chapter II. The Recommended Year 2020 Network was also evaluated so that the measures of effectiveness for the network are compared to existing conditions as well as to the other alternatives developed during the study process

3. Year 2050 Analysis

The focus of the Year 2050 analyses is on the potential for future land use policy decisions which could provide transportation system benefits. The primary objective of the land use analysis is to determine what reductions in vehicular travel demand can be achieved by improving the localized balance between jobs and households and locating development closer to transit stations.

- **Overview**

  The Year 2050 analyses included a total of six scenarios, matching three alternative land use scenarios and three alternative transportation network scenarios. These scenarios are summarized in **Table 3-2** and the land use and transportation network components are described below.

Table 3-2: Year 2050 Scenarios

Alternative	Land-Use Assumption	Transportation Network Assumptions
A	Master Plan	Master Plan
B	Master Plan	Enhanced Network #1
C	Transit-Focused	Master Plan
D	Transit-Focused	Enhanced Network #1
E	Locally Balanced	Master Plan
F	Locally Balanced	Enhanced Network #2

- **Land Use Scenarios**

Three land use scenarios were developed for the Year 2050, described as:

- Master Plan Scenario
- Transit-Focused Scenario
- Locally Balanced Scenario

The amount of Montgomery County development in each of these scenarios is approximately 750,000 jobs and 480,000 households, as shown in **Table 3-3**. The consistency in the total land uses facilitates comparison of the land use development pattern effects on the transportation system.

Table 3-3: Existing and Future Land-Use Scenarios

Totals	1998	2020	MPBO*	MPBO 2050	Transit-Focused 2050	Locally Balanced 2050
Households	308,000	390,000	478,000	478,000	480,000	479,000
Total Jobs	484,500	630,000	1,029,000	750,000	750,000	746,000
Percent Change		**%Change 1998-2020**	**% Change 2020 to MPBO**	**% Change 2020-t0 2050**	**Transit 2050 Focused**	**% Change 2020 to 2050**
Households		27%	23%	23%	23%	23%
Total Jobs		30%	63%	19%	19%	18%

* MPBO = Master Plan Buildout

The difference between the three land use forecasts is the means by which development projected to occur between 2020 and 2050 was distributed throughout the County. All three scenarios assumed that the MWCOG Round 6 demographic forecasts for 2020, used in the 2020 horizon year analyses, would be retained. Demographic and job growth both inside and outside Montgomery County were projected for the Year 2020 using a straight-line projection of the MWCOG Round 6 growth rates between 2015 and 2020 for individual transportation analysis zones in the model. For each of the three land use scenarios, total County-wide jobs and households are approximately 20% higher in the Year 2050 than in the Year 2020.

The difference between the land use scenarios was the way in which growth from Year 2020 to Year 2050 was distributed within Montgomery County. The Master Plan Scenario assumed that development beyond Year 2020 would occur based on the patterns established by the County's current master plans. The Transit-Focused Scenario assumed that employment growth beyond the Year 2020 would be even more clustered in transit-oriented activity centers than assumed by current zoning. The Locally Balanced Scenario, developed by developed by members of the Project Advisory Team with the cooperation of the Citizen's Planning Association, assumed that both jobs and employment growth beyond Year 2020 would be redirected to balance the number of jobs and households within individual communities.

In a sense, all three land use scenarios deviate somewhat from the County master plans because, while all assume the full zoning envelope buildout for households, none assumes the full zoning envelope for employment. As shown in **Table 3-3**, the master plans will support a County-wide employment total of over 1,000,000 jobs. The Master Plan Scenario was developed by a proportional reduction of job growth between Year 2020 and Master Plan Buildout down to a total of 750,000 jobs.

- **Transportation Network Assumptions**

Three transportation networks were used in the Year 2050 analyses. First, all three land-use scenarios were tested against a Year 2050 base transportation network. The 2050 Base transportation network was based on master plan transportation recommendations within Montgomery County and the CLRP network outside Montgomery County.

The effect of additional transportation services on Year 2050 travel demands was examined using two "enhanced" Year 2050 transportation networks. Both enhanced networks used the 2050 Base Network and added services as described below:

Enhanced Network #1 added the improvements tested in Network Alternative K from the alignment alternative analyses (shown previously in **Table 3-1**) and additional stations on the Corridor Cities Light Rail Transit alignment.

Enhanced Network #2 added the improvements included in Enhanced Network #1 and additional stations on the Metrorail Red Line and the US 29 Light Rail Transit alignment.

The evaluation of the Year 2050 Scenario is included in **Chapter IV.**

Chapter IV: Evaluation Process

This Chapter presents the process of evaluation for the Year 2020 combination alternatives detailed in Chapter III, and how they and the Recommended Network perform relative to the various Measures of Effectiveness. The results are provided in a quantitative manner where possible, although some subjective, qualitative judgments are presented as well. The final section presents the results of the Year 2050 testing, with a discussion of the land use and transportation network finding resulting from that work

1. Development of Findings

One of the primary findings of the TPR is that there is no "silver bullet" solution to address the County's travel needs. A corollary to that finding is that there is no one project or Recommended Network that stands head and shoulders above the others in terms of effectiveness in providing for transportation needs.

The development of the Recommended Plan for the Year 2020 and the findings regarding the Year 2050 analyses require both quantitative and subjective analysis. Several principles emerged which influenced the final staff decisions on the Recommended Plan.

Larger expenditures yield greater benefits. The primary objective of the TPR is to recommend the most appropriate Year 2020 transportation system for the County in order to begin the process of defining a fiscally constrained long-range plan for the region. In other words, the TPR is not completely bound by budgetary constraints. This allowed a "Max Build" alternative to be tested. An obvious trend common to the graphs and tables presented in this section is that the most extensive, and therefore expensive, networks provide the best improvements in mobility and accessibility.

Implementation takes time. If cost is not an overriding factor in this study, one might ask why not include all the projects which improve the transportation system in the Recommended Plan. The primary reason is that even if funds could be acquired to construct the theoretical "Max Build" network, the complexities of the approval, design and construction process, including the environmental review process, would realistically preclude many concurrent, interwoven transportation projects from being constructed within a twenty year time frame. It is also recognized that, with the financially constrained nature of the CLRP, funds must be identified for the recommended projects.

The cost per unit of positive change measures "efficiency." Recognizing implementation time constraints, the evaluation process has prioritized those projects most critical to addressing the Montgomery County transportation needs during the next 20 years. Part of the prioritization process consists of evaluating the measures of effectiveness in relation to the capital cost. This measure of efficiency is described under the discussion on optimizing public investment, and was a high factor in staff's recommendations.

There are benefits and problems with all the proposals. Some of the six goals for the TPR can be diametrically opposed. Achieving paramount performance in one goal such as mobility, usually means sacrificing progress toward another goal, such as minimizing environmental impacts. A single benefit-to-cost ratio has therefore not been included as a measure of effectiveness because such a measure requires making subjective decisions regarding the relative values of mobility, accessibility, environmental resources, and community cohesion. The report allows the reader to independently conclude the value of the Recommended Plan by providing both quantitative data and qualitative review of the degree to which each network addresses the TPR goals.

None of the alternatives maintain today's conditions. Transportation services cannot be implemented quickly enough to match the forecast growth in travel demand. Therefore, for nearly all measures of transportation mobility, area-wide roadway conditions in the Year 2020 will be worse than they are today regardless of which projects are implemented.

This principle, that auto mobility will be worse by 2020 under any of the evaluated alternatives, must not be interpreted as a statement that transportation improvement efforts are futile. Rather, it is a call for action on all three fronts: land use planning, transportation policy, and transportation service to address the future needs. The Recommended Plan has been selected as the most effective and efficient means of addressing the travel needs during the next two decades. The public good provided by the Recommended Plan's achieving the study goals, measured against the future baseline conditions, is commensurate with the estimated capital cost of the Plan.

County-wide reviews cannot evaluate localized projects. The purpose of the TPR is to identify and focus on County-wide needs. The County is large enough that no single transportation service or project appears to have a significant effect when viewed from a County-wide perspective, and networks of projects are essential for good planning. It was not possible to test individual projects except through comparisons between networks and interpretation of results. This is easier for larger projects such as the transitways, busways, and longer roadway links.

The decision to include or exclude from the Recommended Plan individual "smaller" roadway projects and interchanges incorporates the results of prior, localized, plans and studies. For example, the effects of the Brookeville Bypass have not been explicitly reviewed as part of the TPR analyses. Although coded in the model network, it is not a key link, and its effects on mobility or accessibility are not observable from a County-wide or even corridor perspective. From a local perspective, however, staff concurs with the County Council assessment through the master plan analysis that the Brookeville Bypass is a needed project and it has been included in the Recommended Plan. This same philosophy is applied for most of the roadways in the Recommended Plan, since most of them have been previously included in the 1998 CLRP, and all are in the applicable master plans.

2. Year 2020 Measures of Effectiveness Analyses

The focus of the Year 2020 analysis is on the evaluation of alternative transportation networks to serve the County-wide and regional land use forecasts. The following sections present the measures which describe how effective the Recommended Plan and the combination alternatives are in meeting each of the TPR goals and MOEs.

Measures of effectiveness are presented for seven alternatives:

- 1998 Base
- 2020 Base
- 2020 Montgomery County Council Network (Combination Network A)
- 2020 Mixed Mode Network (Combination Network B)
- 2020 Light Rail Emphasis Network (Combination Network C)
- 2020 Max Build Network (Combination Network D)
- 2020 Recommended Plan

The components of the 2020 Recommended Plan are described in **Chapter II** and the components of the combination alternatives A through D are described in **Chapter III. Table 4-1** presents the results of the analysis of the alternatives with similar information on the 1998 and 2020 Base Case (current CLRP). It uses the transportation forecasts of the evening peak hour for vehicle travel and of evening peak period (three hours) for transit ridership.

Although presented here together, the alternatives were created sequentially with efforts to build on the knowledge gained from reviews of results. The Recommended Plan was created from pieces of the other combination plans, after consideration of how they were performing overall and in key corridors.

3. Mobility

Mobility is evaluated by four measures of effectiveness forecast for Year 2020: for auto vehicle miles of travel (VMT), vehicle hours of travel (VHT), the average roadway speed, and the percentage of County-wide lane miles that will be congested. For transit, the mobility measure is the number of transit boardings. Each of these is described individually in the following section. **Table 4-1** includes the information referred to. Figures are also provided for some of the MOEs.

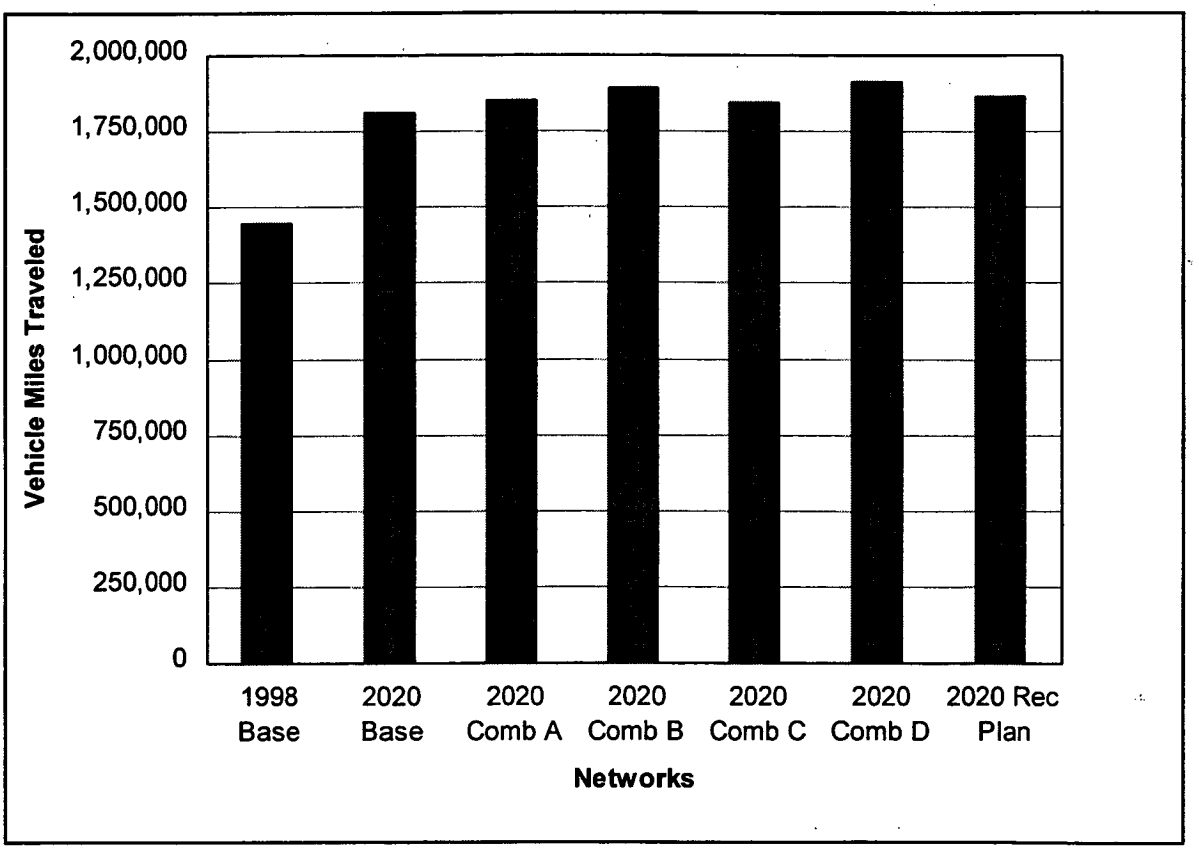
To understand some of the evaluation results for the alternatives, the transportation network must be viewed as a dynamic system in which an improvement to one facility may have impacts on travel patterns. Transportation improvements may affect travel in a number of ways: by shifting the routes taken by vehicle trips, the mode of travel (i.e., between transit and auto), the time of day the trip is made and even the origins and destinations of trips. Thus, there is no simple cause-and-effect relationship with travel.

Table 4-1: Comparison of 2020 Alternative Networks

Measures of Effectiveness (MOEs)	1998 Base	2020 Base	2020 Comb A	2020 Comb B	2020 Comb C	2020 Comb D	2020 Rec Plan
Auto Mobility							
Total Lane-Miles	2,472	2,606	2,619	2,796	2,730	2,792	2,791
Vehicle-Miles Traveled (VMT, thousands)	1,446	1,814	1,854	1,890	1,848	1,910	1,867
Vehicle-Hours Traveled (VHT, thousands)	55	102	109	93	94	96	89
Average Speed (Miles/Hour)	26.1	17.7	17	20.4	19.6	19.8	21
Percent of Lane-Miles Congested	9.7%	20.6%	22.7%	18.7%	19.4%	19.8%	17.0%
Transit Mobility							
Number of Transit Boardings (thousands)	66.5	100.3	116.7	133.5	138.9	149.8	142.8
Bus	30.6	58.4	49.4	78.3	42	58.2	71.6
Rail	35.9	41.9	67.3	55.2	96.9	91.6	71.2
Transit Accessibility							
Countywide Accessibility Index to Households (thousands)	98	104	115	129	138	146	137
Countywide Accessibility Index to Jobs (thousands)	182	194	213	240	267	281	254
Activity Center Accessibility Index to Households (thousands)	155	162	181	204	250	261	229
Percent of Jobs within 1/2 mile of Rail Stations	40%	37%	50%	50%	61%	61%	56%
Percent of Households within 1/2 mile of Rail Stations	13%	15%	20%	20%	26%	26%	20%
Average Transit Travel Time (minutes)	55.9	60.4	55.3	48.2	47.6	45.9	46.8
Auto Accessibility							
Countywide Accessibility Index to Households (thousands)	546	647	643	722	653	726	748
Countywide Accessibility Index to Jobs (thousands)	423	1,134	1,121	1,189	1,107	1,235	1,286
Activity Center Accessibility Index to Households (thousands)	195	658	656	741	669	740	771
Average Auto Travel Time (minutes)	26	35.2	38	32.6	33.9	32.6	31.1
Mode Share							
Transit	17.5%	18.6%	19.6%	21.3%	21.5%	21.9%	21.6%
Single-Occupancy Vehicle (SOV)	70.7%	67.9%	67.2%	65.7%	65.4%	65.2%	65.4%
High-Occupancy Vehicle (HOV)	7.8%	7.6%	7.6%	7.5%	7.4%	7.4%	7.5%
Walk/Bike	4.0%	5.8%	5.6%	5.5%	5.6%	5.4%	5.5%

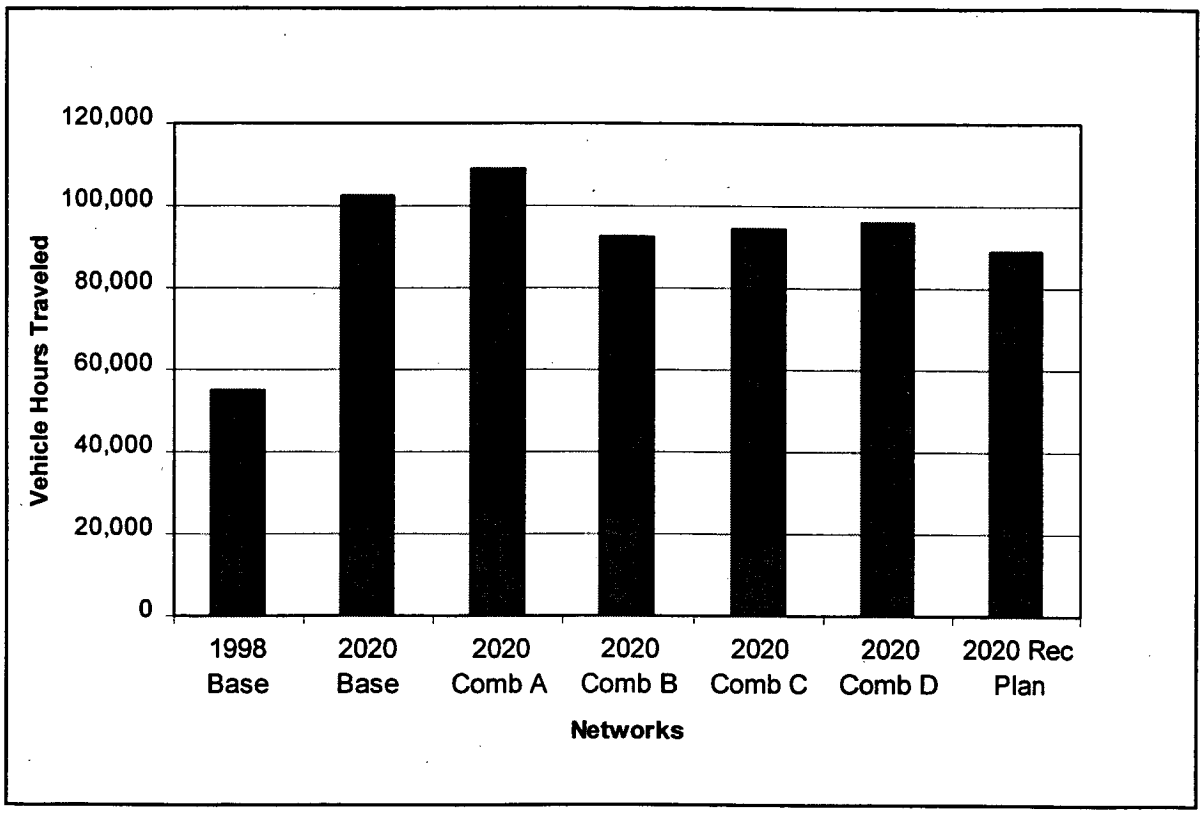
Vehicle Miles of Travel: This is a MOE that is often considered when reviewing networks, and it is one of the most complex to understand in terms of performance. (See **Figure 4-1**.) Vehicle miles traveled increases over the base case for all the alternatives. This is because each of them provides a **better** roadway network, which allow demand to be accommodated. Although from an air quality perspective, lower VMT is desirable, from a mobility perspective, constraining trips with congestion is not a good method to reduce it. If VMT is increased while transit and other roadway characteristics are improving this is not necessarily an undesirable trend. Of the alternatives, the Recommended Network is about the same VMT as combination A and D while B and C show increases. It is difficult to draw any conclusions from this MOE except in context with the ones following.

Figure 4-1: Vehicle Miles Traveled



Vehicle Hours of Travel: Each of the combination networks reduce total vehicle hours traveled. **Figure 4-2** shows the aggregate number of vehicle hours traveled on Montgomery County roadways during the evening peak hour. Currently, about 55,000 vehicle hours are logged on County roads during the evening peak hour. By the Year 2020, this number will nearly double to 102,000 vehicle hours. The four combination networks reduce the amount of travel time by up to 13,000 vehicle hours. The Recommended Plan includes about 90,000 vehicle hours of travel, a reduction of 12,000 vehicle hours, or 12% from the base case. **The Recommended Plan reduces vehicular travel times by 12%**

Figure 4-2: Vehicle Hours Traveled



The reduction in vehicle hours of travel provided by the combination networks and the Recommended Plan is caused by two factors. First, the roadway network improvements provide additional capacity, which reduces congestion and improves travel times. Second, the improvement to transit networks and services makes transit more attractive, causing some travelers to shift their travel mode choice from auto to transit. The reduction in vehicle trips therefore also reduces congestion and improves travel times. A synergy exists between transit and auto user benefits in this regard, as the improvement in roadway travel times also makes local transit service more rapid and therefore more efficient.

Cost Recovery Calculation: the extent of travel time savings associated with the Recommended Plan can provide a persuasive numerical argument for investing public resources in transportation. **The travel time savings of 13,000 vehicles in a typical peak hour could also be expressed as follows:**

- 78,000 vehicle hours on a typical weekday, assuming that the peak travel period lasts for three hours during the morning and three hours during the evening
- 85,800 person hours on a typical weekday, assuming that vehicles contain an average of about 1.1 persons
- 21.5 million person hours during a typical calendar year, assuming that there are 250 weekdays in a year
- $215 million per year, assuming that the average value of time to auto travelers is about $10 per hour

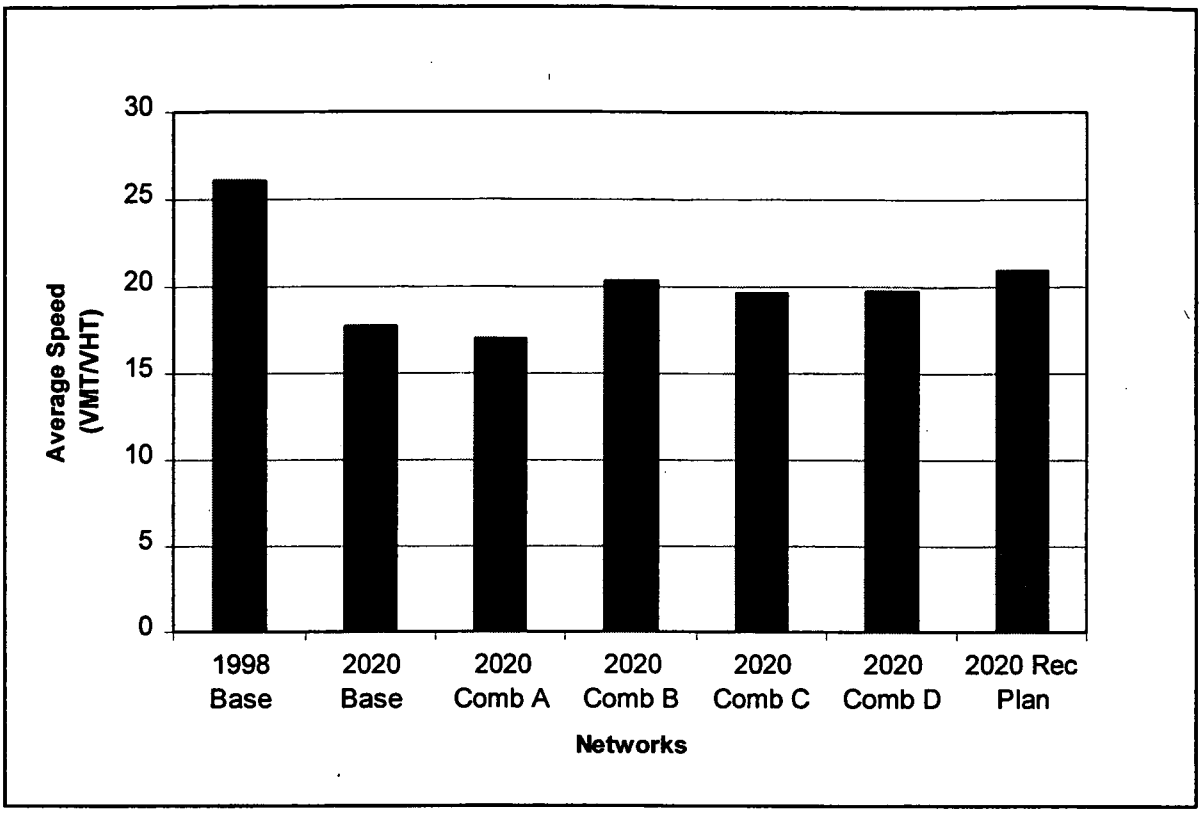
Therefore, it takes only 14 years to accrue the travel time benefits associated with implementing a $3 billion County-wide transportation program.

This type of justification is controversial, since there are widely divergent estimates of the value of time. This analysis is not meant to be interpreted as a bottom-line cost/benefit analysis, but merely to demonstrate that the public benefits of the Recommended Plan generally appear to be in line with the public costs.

Average Speed: The average travel speed is an average of forecast peak-hour travel speeds throughout the County, weighted by traffic volume. This measure, shown graphically in **Figure 4-3**, is calculated by dividing the County-wide vehicle miles of travel by the County-wide vehicle hours of travel, thereby obtaining County-wide vehicle miles per hour. The graphical comparison of travel speeds is nearly identical to the comparison of vehicle hours of travel, and the causative factors for increased speeds are the same as those described above. The only difference between vehicle hours of travel and average travel speeds is that the network improvements do cause a slight increase in the vehicle miles of travel, an evaluation measure described below under environmental effects. **The Recommended Plan increases average travel speeds by 18%.**

Percent of Lane Miles Congested: The geographic extent of congestion can be evaluated by comparing the number of lane miles which operate under congested conditions during the peak period. This is calculated by defining congestion as a roadway link with a volume to capacity ration of 1.0 or higher. This measure has obvious limitations since it does not show how much over or under capacity the link is, or what classification the road is. Nevertheless it is an indication of the changes occurring on the roadway network due to the other system changes. As show in **Table 4-1**, about 10% of the County's lane miles are congested during the evening peak hour and, by the Year 2020, about 21% of the lane miles will be congested assuming the Base network in place. **The Recommended Plan reduces the extent of traffic congestion by 14%**

Figure 4-3: Average Speed

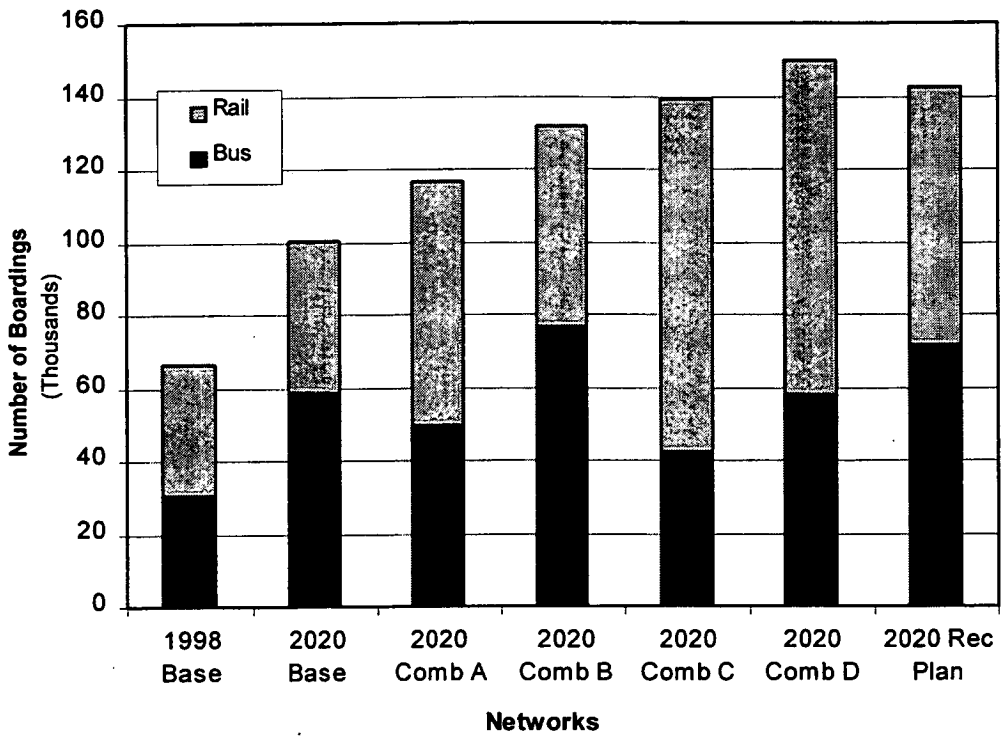


These values may seem low, considering the degree to which congestion affects most travelers in the County. Two characteristics of the means by which this measure is derived from the travel demand model may facilitate its understanding. First, the measure includes all roadway segments in both directions of travel during the evening peak hour. For many roadways, particularly radial routes such as I-270, Georgia Avenue, or US 29, congestion exists in the northbound lanes but not in the southbound lanes. Therefore, even those roadways we view as the most congested may truly experience congestion in just half of their lane miles. The second characteristic of the travel demand model is that the model identifies "congestion" only at the true bottleneck locations but does not reflect the effects of upstream queuing. For instance, during the evening peak hour the model may recognize congestion on I-270 northbound at the point where the express lanes end but will not identify segments south of that merge point as congested, even though motorists begin to experience congestion before the merge location.

Both Alternative D and the Recommended Alternative reduce the percentage of congested lane miles by about 14%. Like the other mobility measures of effectiveness, the improvement is due both to increased roadway capacity and a shift for some travelers from auto to transit.

For **transit mobility, the key measure is the number of transit boardings,** both rail and bus, shown on **Figure 4-4**. This measure includes multi-mode trips, such as when a bus passenger transfers to rail. It is one of the best in showing the large increases in transit use that the future networks will create, and how the networks differ in their future use. Network C and D have more rail services than the others, and the boardings are much more heavily weighted toward rail. Network B is more balanced, but has total boardings on the low end of the networks. The Recommended Network has a balance between bus and rail boardings, and has the next highest total to D. All the alternatives more than double current transit boardings, a good indicator given the strong transit orientation of the future plans.

Figure 4-4: Transit Boardings



4. Accessibility

Jobs and Household Accessibility. This is the basic measure of network accessibility -- the ability to reach multiple destinations. In Section Three, the example of increased accessibility from a residence to grocery stores was cited: a house with three stores within a five minute trip is more accessible than a house with only one store within a five minute trip. For the purpose of the TPR, accessibility is measured in terms of the number of jobs and households within a 45-minute trip by either auto or transit. The change in accessibility is assessed by considering the average increase in the number of jobs and households available with an alternative transportation network in place. **The Recommended Network**

greatly expands the ability of travelers to reach new destinations, although a more extensive rail network can increase transit access more.

The change in access is described as the **accessibility index. Six measures of accessibility** are described in this report: auto and transit for each of the three accessibility criteria in **Table 4-2.**

Table 4-2: Accessibility Index Criteria
Separately Calculated for Auto and Transit Travel

Accessibility Criteria	Travel From	Travel To
County-wide Household	Jobs in Montgomery County	Households Region-wide
County-wide Jobs	Households in Montgomery County	Jobs Region-wide
Activity Center to Household	Jobs in Montgomery County Activity Centers	Households Region-wide

Two additional measures could be examined: the degree to which jobs region-wide are accessible from households in Montgomery County activity centers by auto and by transit. However, in reviewing the future forecasts of land use, it becomes clear that the Montgomery County activity centers, despite being mixed use, are nevertheless more job-oriented than household-oriented, due to a combination of historic development patterns, economic policies, and market forces. Staff considers that the ability to reach a job in the activity centers from other points in the region is far more important than being able to reach jobs throughout the region from the relatively few households in the activity centers. All of the transportation networks evaluated were developed with this implicit value in mind. **Therefore, none of the networks performs very well at linking activity center households to regional jobs, and the measure is not a discriminating factor for evaluating alternative networks.**

Table 4-3 demonstrates how the accessibility index for the Recommended Plan is calculated, using transit accessibility from activity center jobs to regional households as an example. The leftmost columns in **Table 4-3** show the number of jobs for each of the twelve activity centers included in the analysis. Consider the Bethesda CBD, the first activity center listed, with a 2020 employment level of 44,804 jobs. From the Bethesda CBD, a traveler in the year 2020 will be able to travel within 45 minutes on transit to any one of 299,065 households in the region. This is a measure of value of the Bethesda CBD.

Table 4-3: Household Accessibility Index For 2020 Recommended Network

Transit, Walk Connect

This table shows the number of regional households accessible from employment activity centers within 45 minutes in the peak period.

Activity Center	Jobs	2020 Base Accessible Households	2020 Recommended Network Accessible Households	Absolute Change	Percent Change	Absolute Change x Jobs
Bethesda	44,804	299,065	350,945	51,880	17%	2,324,431,520
Clarksburg	3,222	10,443	46,435	35,992	345%	115,966,224
Germantown	20,228	25,418	50,358	24,940	98%	504,486,320
Lake Forest	10,489	55,530	64,071	8,541	15%	89,586,549
Life Sciences	14,076	26,740	91,946	65,206	244%	917,839,656
Olney	6,411	28,086	40,888	12,802	46%	82,073,622
Rock Spring Park	30,892	36,289	181,777	145,488	401%	4,494,415,296
Rockville	13,716	113,257	143,010	29,753	26%	408,092,148
Silver Spring	38,027	364,767	440,378	75,611	21%	2,875,259,497
Twinbrook	20,354	126,349	168,050	41,701	33%	848,782,154
Wheaton	12,088	154,125	206,955	52,830	34%	638,609,040
White Oak	17,941	87,680	211,992	124,312	142%	2,230,281,592
	232,248					15,529,823,618
				Activity Center Weighted Average Increase Over 2020 Base		66,867

Because the Bethesda CBD is relatively centrally located in the Washington region and well served by transit, it is one of the most accessible activity centers, second only to Silver Spring (with 364,767 households accessible within 45 minutes by transit). At the other end of the spectrum, the Clarksburg activity center is poorly served by transit and surrounded by low-density housing developments. Only 10,443 households can be reached within 45 minutes from Clarksburg. This is, to a great extent, the reason why commercial space is more expensive in Bethesda than in Clarksburg. An employer in Bethesda can recruit a prospective out-of-town employee by pointing out that there are nearly 300,000 houses from which to select a future home if one wants to be within 45 minutes of work via transit.

The Recommended Network improves transit service to and from the Bethesda CBD. The most relevant improvement is the Georgetown Branch light rail alignment, which brings Silver Spring several minutes closer by transit and, by extension, other stations along the eastern branch of the Metrorail Red Line become closer as well. With the Recommended Network in place, a total of 330,053 households would be transit accessible within 45 minutes, an increase of 30,998 households, or 10% over the base condition. The synergy between the size of the Bethesda CBD and the increase in household accessibility is obtained by multiplying the number of jobs in Bethesda by the number of newly accessible housing units, as shown in the last column. This last column demonstrates that the Recommended Plan makes possible a total of nearly 1.4 billion new matches between individual Bethesda CBD jobs and individual households throughout the region.

The remaining lines of **Table 4-3** demonstrate the same calculations for each of the remaining activity centers. Rock Spring Park is the activity center which has the greatest increase in potential new matches, by virtue of both its size (the third most developed activity center on the list with 30,892 jobs) and the number of households (138,840, due primarily to the North Bethesda Transitway connection to the Metrorail Red Line) newly accessible by transit.

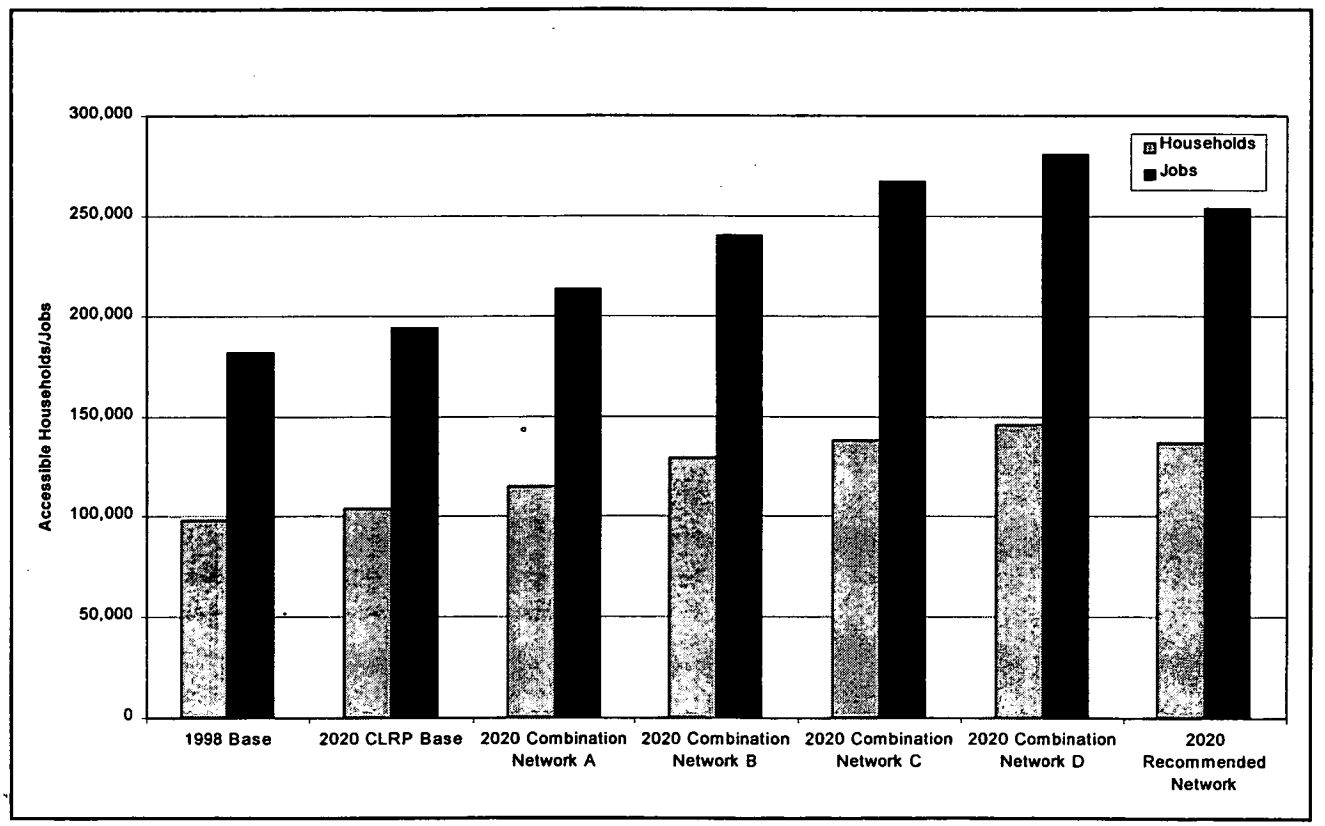
The **household accessibility index** for activity centers under the Recommended Plan is obtained by dividing the total number of potential new jobs-to-housing matches by the total number of jobs in the activity centers. The resulting accessibility index of 59,750 can be interpreted as:

> "If you work in an activity center in Montgomery County, and the Recommended Plan is implemented, it will increase the number of houses you can reach from your job site in 45 minutes by transit by nearly 60,000".

The same process is used to calculate accessibility indices for the remaining combinations, shown in **Table 4-1**. For County-wide accessibility, the County totals, rather than activity center totals, are considered. For auto accessibility, the increased number of jobs or houses within 45 minutes by auto, rather than by transit, is considered. Each of these is discussed separately below.

The **Transit County-wide Accessibility Index to Household and Jobs** is shown on **Figure 4-5**. The light colored and shorter bars show the jobs accessibility, with the darker ones showing households. For jobs (from households County-wide), Network D performs best (38% gain over Base), with Network C about the same, and the Recommended slightly lower(31% gain). This is an indication that a larger rail system, as provided in Networks C and D, will access some areas that the Recommended does not. Rail lines along US 29 and the outer circumferential rail lines are included in the Networks C and D and not in the Recommended. However, little is gained between C and D, although the D network is more extensive. Networks A and B perform less well in regard to transit access, and the CLRP base is only slightly above 1998 levels. The expanded transit network in B, C, D and Recommended all bring many thousands of additional households within 45 minutes by transit, greatly increasing travel choices.

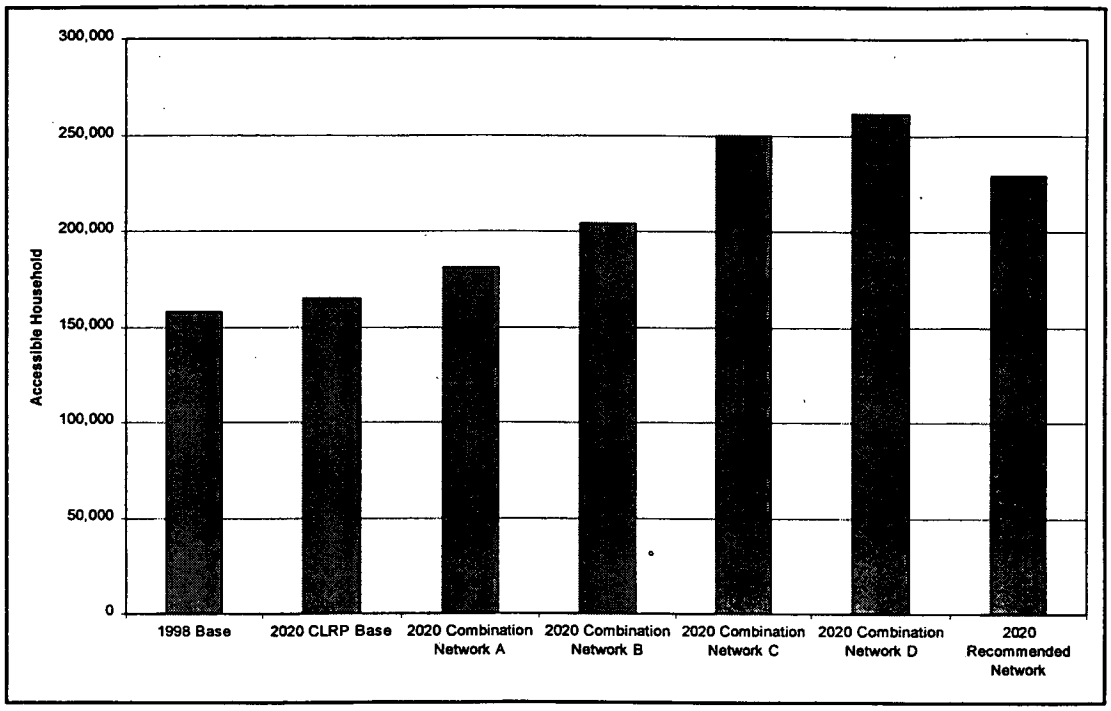
Figure 4-5: Transit County-wide Accessibility Index to Households and Jobs



For the households accessible from jobs the picture is somewhat different, with the Recommended network performing about the same as Network C (32% gain over Base), with only the extensive Network D being better (41%). Network B is a 24% gain with A less than that.

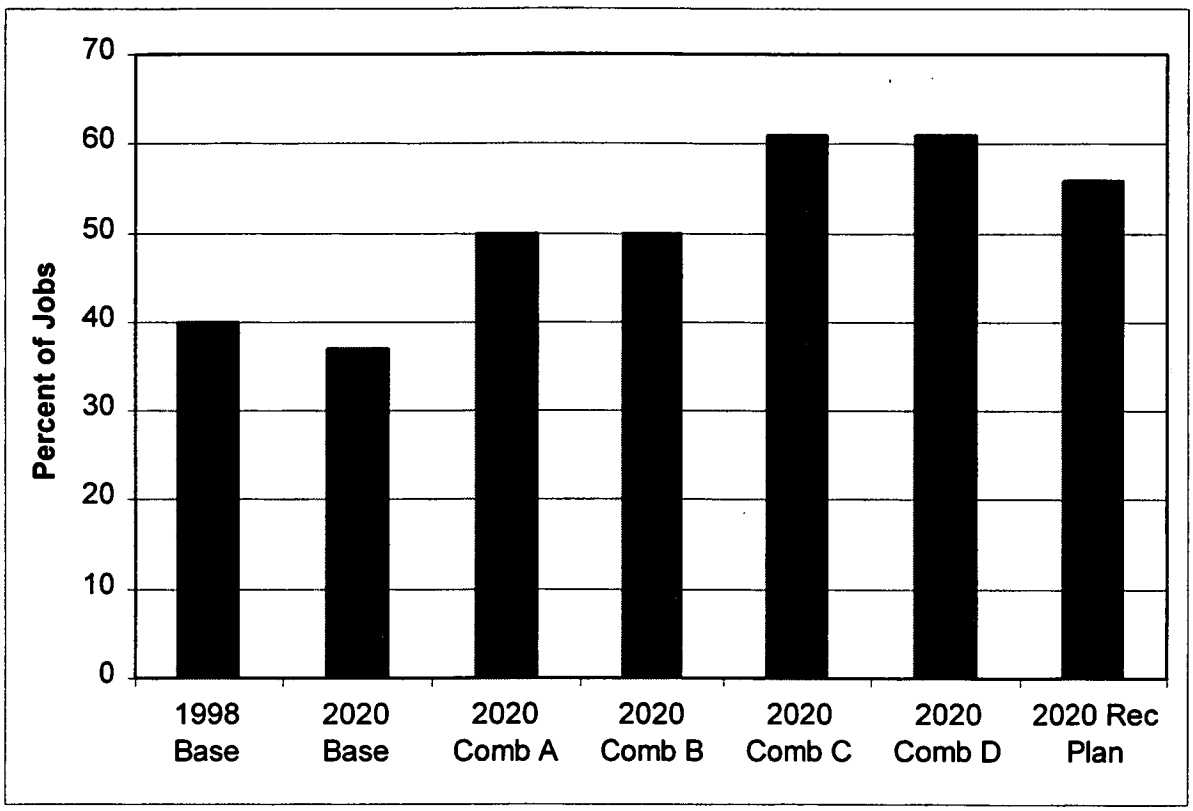
The Transit Activity Center to Households Accessibility Index is on **Figure 4-6**. This important characteristic shows the households that can be reached via transit from jobs in the 12 activity centers of the County. As with County-wide household access, Network D and C are about the same, with 250,000 or more households accessible, a 54% increase for Network C over the Base condition. The Recommended Network is about 41% improvement, with B and A significantly lower. As with the County-wide household access, this is due to the additional rail stations along US 29 and the cross-County rail in the Networks C and D which brings rail closer to some additional centers such as FDA/White Oak.

Figure 4-6: Transit Activity Center to Households Accessibility Index



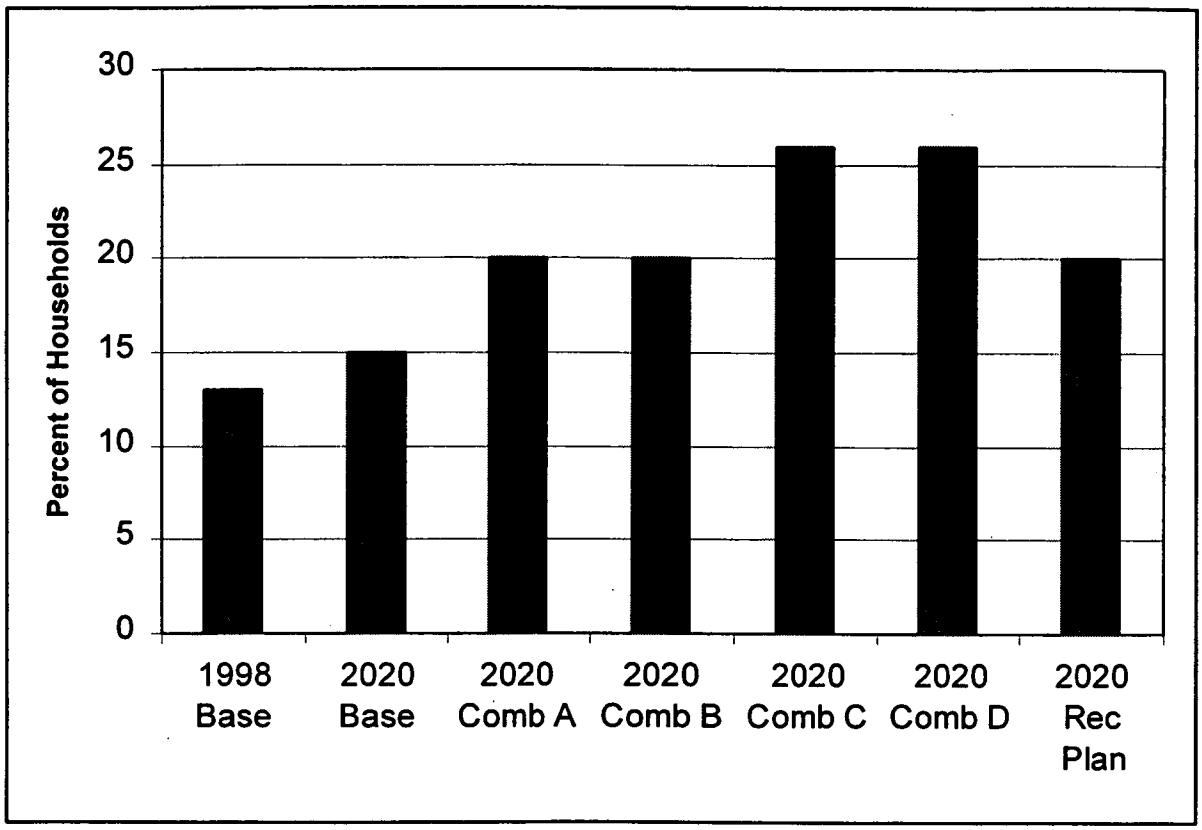
The Percent of Jobs Within a ½ Mile of Rail Stations is on **Figure 4-7**. This shows the percent of total County jobs potentially walkable from a light rail or Metrorail station. The high numbers indicate the success of County policies to locate jobs in activity centers; the plans to serve these with rail service. Rail-oriented Networks D and C have the highest percentages, at 61%, with the Recommended Network at 56%, and Network B at 50% with Network A. Without the additional transit in the expanded networks the Base will produce only 37%, lower than today's situation (40%). Note that the Year 2020 estimates are on a much higher total number of jobs than 1998.

Figure 4-7: Percent of Jobs within ½ Mile of Rail Stations



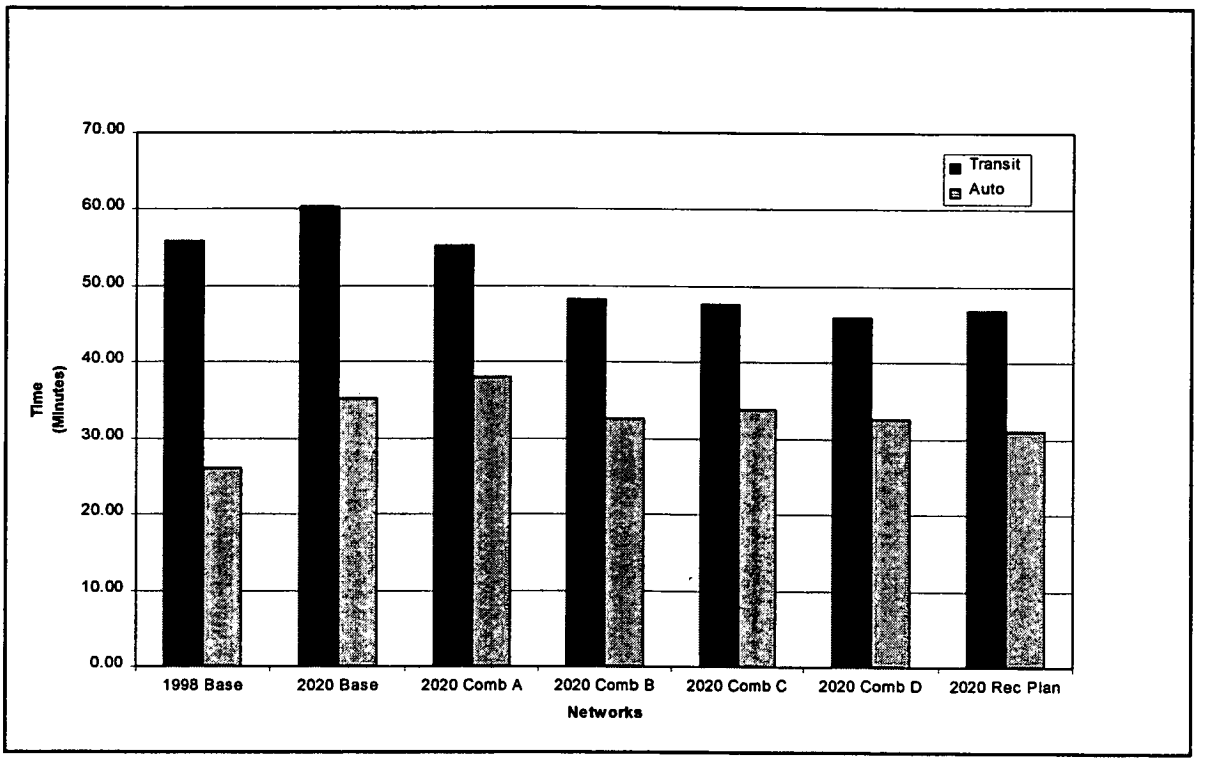
The Percent of Households within a ½ mile of Rail Stations in Figure **4-8** With total figures lower than jobs, the pattern changes some. For this MOE, Networks C and D have 26% of future households walkable, while the Recommended, A and B are at 20%. This is due to the generally less concentrated nature of County housing, with a much smaller percent in activity centers where they can be accessed via walk from rail stations.

Figure 4-8: Percent of Households within ½ Mile of Rail Stations



Average Transit and Auto Travel Times are shown on **Figure 4-9**. This in an estimate of the average transit and auto trips taken in the future to reach jobs and households in the evening peak period from County Activity Centers. As with the other indicators, it includes only transit trips walk access.

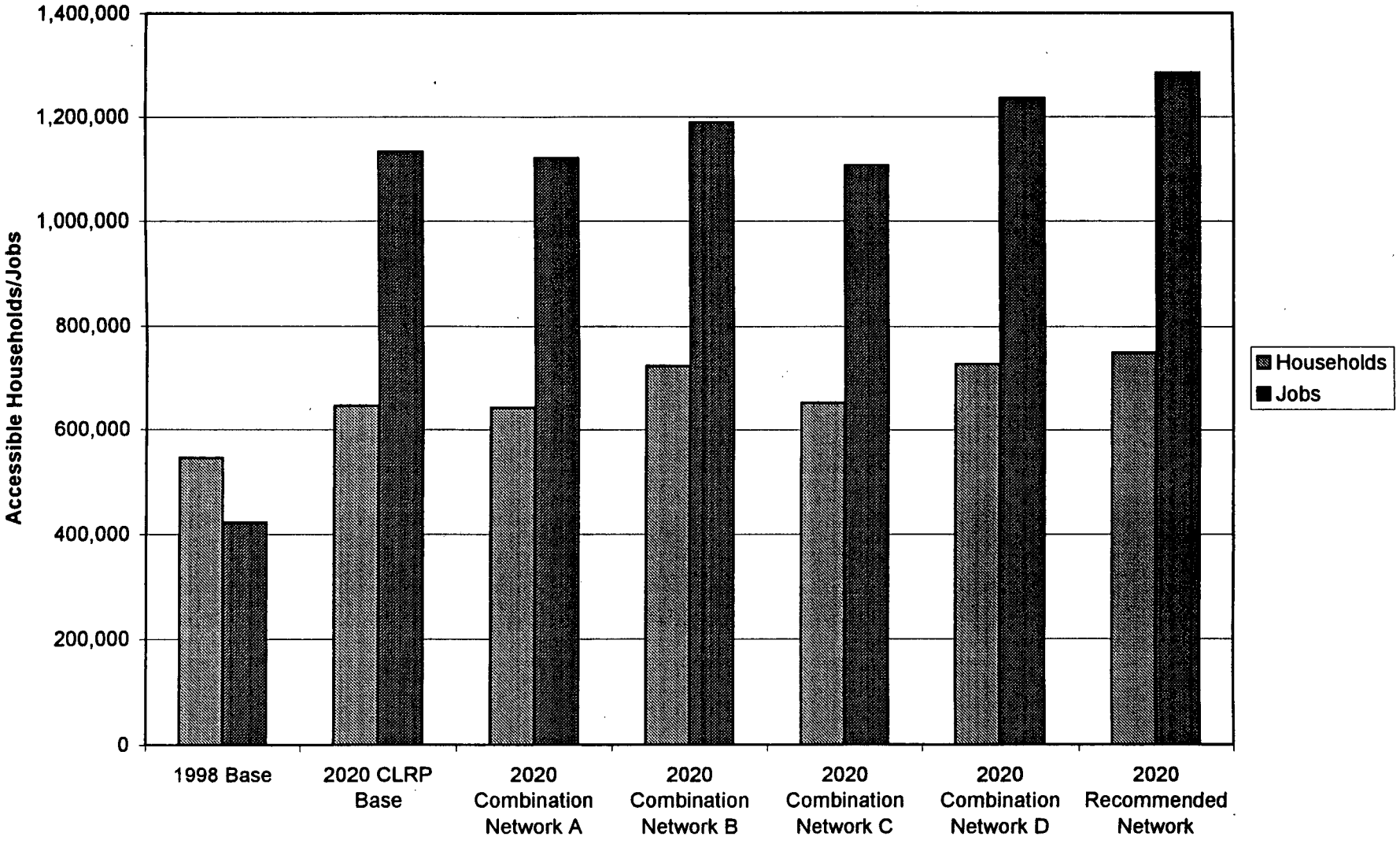
Figure 4-9: Average Travel Times via Transit and Auto from Activity Centers to County-wide



Auto County-wide Household and Jobs Accessibility Index in shown on **Figure 4-10**. As with the transit access graph, the households are in the light, shorter bars, the jobs in the darker, longer ones. Because of the extensive existing roadway network, the changes here are not as large as for transit. For job access from households, Networks D and the Recommended perform about the same -- around 10% improvement over the base, with the others doing less well. Network A is slightly lower than the Base. This is true for a number of travel characteristics, and is apparently due to the distribution function in the forecasting process described in more detail in the initial part of this section.

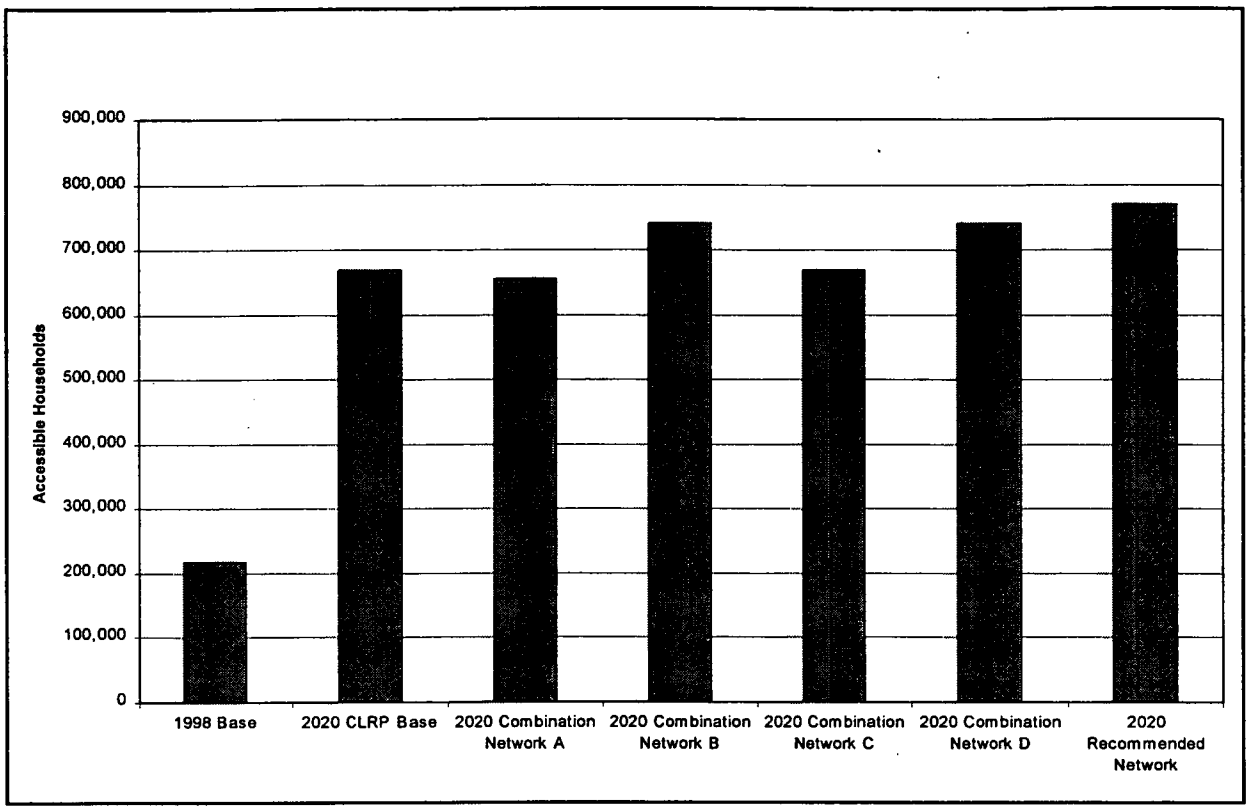
The patterns for household access from jobs by auto are somewhat different. With this indicator, the Recommended performs best of any with 16% increase, with D at 13% and B at a 12% increase.

Figure 4-10: Auto Countywide Accessibility Index to Households and Jobs



Auto Activity Centers to Household Accessibility Index is shown on **Figure 4-11.** As with households, the Recommended performs best with an 17% improvement, followed by Networks D and B at about 12%.

Figure 4-11: Auto Activity Center to Households Accessibility Index



5. Reducing Negative Impacts on the Environment

At the sketch-planning level of this report, determining environmental impacts is difficult because exact alignments and cross sections are not available. Staff prepared an initial assessment of the **potential** problem locations, and this is presented at the end of this Chapter. It is clear that the recurring environmental impacts of east-west transportation projects having to cross north-south streams and stream-valley parks will again be major issue. Historic resources are present in many locations, and must be included in any project-level analysis.

Some other criteria can be at least indirectly related to environmental impacts as well. One example, Vehicle Miles of Travel is an indirect indicator of air pollutants from vehicles, and its reduction is a positive for air quality. However, slower speeds and more congested conditions result in vehicles spending more time on the roads, and this contributes to air pollution as well.

Because of the inherent conflict between construction of new transportation facilities and reducing environmental impacts, the combination alternatives that are more extensive are going to have more impacts on the natural environment. The more extensive networks also tend to have more VMT. However, the more extensive networks also have the lower total vehicle hours of travel.

The Recommended Alternative performs about in the middle of the networks in minimizing VMT growth and does an excellent job in reducing VHT relative to the Base Case. It does have projects that will impact on the environmentally sensitive areas identified. During any subsequent project, planning actions such as alignment shifting or mitigation will be essential considerations.

6. Supporting Orderly Growth

The intent of the goal to support orderly growth is to provide sufficient transportation network capacity to implement planned growth per the County's master plans, Annual Growth Policy, and Adequate Public Facilities Ordinance. The measures of effectiveness evaluated to assess the goal of increased mobility confirmed that the networks provide increased network capacity. The difference between an overall goal of mobility and one of supporting orderly growth is primarily a function of where geographically the mobility enhancements occur. The goal of supporting orderly growth is designed to ensure that future projects improve mobility in those policy areas where continued economic growth is most desired according to the County's plans.

This is a difficult goal to quantify. Staff has used a measure that focuses on the support of future development in the I-270 Corridor and Bethesda CBD, the two highest planned jobs growth locations in the coming years. It was not possible to perform an Annual Growth Policy Staging Ceiling analysis for all the networks, so a surrogate was used to evaluate the networks relative to each other. The measure applied is the average change in accessibility of jobs to county-wide households from activity centers in the I-270 corridor and Bethesda by transit and auto. The calculation uses a job-weighting calculation by Activity Center similar to that explained for the accessibility index earlier in this Chapter. The Activity Centers used in this analysis are as follows: Bethesda, Clarksburg, Germantown, Lake Forest, Life Sciences, Rock Spring Park, Rockville, and Twinbrook. The result was then rated with the best network getting 100 and the others scaled against that. The ratings are shown in **Table 4-4**.

Table 4-4: Change in Accessibility in Key Activity Centers

Mode	Networks				
	A	B	C	D	Rec
Transit	25	41	91	100	59
Auto	-06	90	11	88	100
Total	19	131	112	188	159

This measure is related to the expected ability for the networks to support growth capacity since the measures used in the AGP incorporate both transit and auto travel. The forecasting process is sensitive to the time penalties associated with congestion. Increases in accessibility within a given period of time indicate improvements to the transportation network. This should translate to the ability to approve planned growth.

The Recommended Network performs best among the non-maximum networks, with Network D, the Max Build Network, showing the most support. As with other alternatives, this indicates the balanced mode approach of the Recommended Network.

7. Supporting and Enhancing Existing and Future Communities

The goal of supporting and enhancing existing and future communities has two primary components. The first is a qualitative evaluation of how well the transportation system supports the current master plans guiding County development. The second is a qualitative evaluation of how well the transportation system supports the state's Smart Growth policies.

Consistency with Area Master Plans. Like each of the other five goals, a failure to meet the goal of consistency with the current planning policy should not be considered a reason to reject the alternative. However, it is a measure to consider. In the Recommended Plan, all major projects are consistent with the currently adopted master plans, and build on the network endorsed by the County Council as part of their priority list. In this regard staff finds the Recommended Plan provides optimum support for the County's master plans. **The major projects proposed in the Recommended Plan are consistent with both the Montgomery County area master plans and Master Plan of Highways.**

Similarly, a policy change would be required to implement some of the more innovative transportation projects in the other alternatives, specifically the circumferential rail either north or south of the Capital Beltway. Of these alignments, only the North Bethesda Transitway and the Georgetown Branch Trolley/Trail are already included in relevant master plans.

Staff recognizes that not including a project in the Year 2020 plan does not mean that its status is changed in any way in master plans. It does recognize that the project will be further away in time in terms of implementation. However, if a planned project is not in the area master plans, the complexity of planning increases. The inner and outer Beltway transit alignments would have to undergo significant discussion about how they would be integrated into the existing and planned communities they would be serving, and how right-of-way would be provided (or they would avoid right-of-way needs such as tunneling, which bring with it complexity of station access).

Support to Planned Communities. How well does the plan provide appropriate transportation services to the communities? This is very subjective and yet is an MOE that is at the heart of good planning. Staff arrived at an approach of evaluating this goal which emphasizes providing light rail transit services to the more dense current and emerging job activity centers to support them in terms of mobility and accessibility and provide an impetus toward clustering. This has tended to emphasize current Central Business Districts in the County, as well as the emerging areas in the I-270 Corridor such as the Life Sciences Center. **The Recommended Plan serves these areas well.**

In regard to this MOE for the other alternatives, the busway alignments in the Corridor Cities Transitway are not seen as attractive for supporting density and clustering. The outer purple line does serve areas of Grosvenor and Wheaton, and this is positive from support of existing and future growth. Networks C and D also perform well on this goal.

8. Optimizing Public Investment

There are two primary means and one secondary means by which the goal of optimizing public investment has been addressed. The two primary means relate to the projected capital cost of implementing the alternative plans. The first of these two means is the actual capital cost of network implementation. The second means is a review of cost effectiveness, or how well each of the networks performs in terms of improvements per million dollars spent. Finally, because some of the costliest elements of the Recommended Plan are fixed-guideway transit systems, the change in forecast transit use is reviewed.

Total Capital Costs: This is the combined estimated cost of all the projects included in each of the alternatives. Capital costs were estimated using a variety of techniques including unit cost estimates, cost descriptions of projects from other sources, and judgement based on costs of similar projects. Because of the admitted broad range of these techniques, the costs shown are best used as "ball park" type costs for comparison among alternatives. Better estimates will require significantly more resources and specialized skills not available during this study.

The estimates for the alternatives included both the projects in the current CLRP carried into the alternatives, and well as the new projects added. The four combination networks range in cost from roughly $1.3 billion to $4.1 billion, as shown in **Table 4-5**. The County Council's recommendation (Combination Network A) is the least expensive and the Max

Build alternative (Combination Network D) is the costliest. Combination Networks B, C, and the Recommended Network are each estimated to cost between $2.5 billion and $3.2 billion. Each of the networks costs more than the $0.8 billion estimated capital cost for the elements in the current CLRP. Details on the costs of individual projects included in each network are shown in **Table 4-6**.The Recommended Network is a "mid-range" solution to the County's problems, relative to the combination networks tested. **The Recommended Network will cost approximately $2.8 billion to implement.**

Table 4-5: Capital Cost Estimates

	In 1998 CLRP	Included in Combo A	Included in Combo B	Included in Combo C	Included in Combo D	Included in Rec Plan
Category						
Rail transit	$235	$574	$235	$2,034	$2,034	$754
Busways	$0	$0	$251	$56	$56	$56
HOV lanes	$0	$0	$562	$0	$562	$562
Roadway construction/widening	$488	$501	$1,056	$696	$1,056	$1,056
Intersections/interchange	$9	$186	$356	$356	$356	$356
Other	$11	$30	$30	$30	$30	$30
TOTAL	$823	$1,291	$2,490	$3,172	$4,094	$2,814

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Notes:

1. Sources of capital cost estimates include MWCOG, MSHA, MCDPWT, and M-NCPPC.
2. The "1998 CLRP" cost estimate has been developed for comparative purposes and therefore varies from MWCOG estimates.

Each of the networks includes rail transit improvements. The lowest investment in rail transit is the $574 million invested in the Georgetown Branch and Corridor Cities transitways in Combination Network A. At the other end of the financial spectrum, Combination Networks C and D also include rail transit in the US 29 corridor and along the two circumferential corridors parallel to the Capital Beltway, for a total of over $2 billion in rail transit infrastructure.

The Recommended Network includes the Georgia Avenue busway, estimated at $56 million. Combination Network B also incorporated a $195 million bus transitway in the Corridor Cities alignment.

Each of the networks contains a substantial amount of roadway improvements, ranging from about $500 million to $1 billion in cost. For the most part, these include those improvements which were in the 1998 CLRP and are necessary to support planned development in the I-270 corridor. Some of these roadway improvements, such as Nebel Street Extended and Watkins Mill Road extended, are also valuable components of the County's transit access network, connecting Metrorail and MARC stations to activity centers for pedestrians and bus riders, as well as autos.

Table 4-6: Detailed Capital Cost Estimates

Category, Project	Capital Cost ($M, 1999)	In 1998 CLRP	Included in Combo A	Included in Combo B	Included in Combo C	Included in Combo D	Included i Rec Plan
Rail Transit							
Georgetown Branch	$235	$235	$235	$235	$235	$235	$235
Corridor Cities Transitway, Shady Grove to Germantown	$195	$0	$195	$0	$195	$195	$195
Corridor Cities Transitway, Germantown to Clarksburg	$144	$0	$144	$0	$144	$144	$144
US 29 LRT	$560	$0	$0	$0	$560	$560	$0
North Bethesda Transitway	$180	$0	$0	$0	$180	$180	$180
Outer Purple Line - Montgomery Mall to White Oak	$250	$0	$0	$0	$250	$250	$0
Inner Purple Line - Bethesda to College Park	$470	$0	$0	$0	$470	$470	$0
Busway							
Corridor Cities Transitway, Shady Grove to Clarksburg	$195	$0	$0	$195	$0	$0	$0
Georgia Avenue Busway, Glenmont to Olney	$56	$0	$0	$56	$56	$56	$56
HOV Lan							
I-270, MD 121 to Frederick County line	$12	$0	$0	$12	$0	$12	$12
I-495, American Legion Bridge to I-95	$550	$0	$0	$550	$0	$550	$550
Roadway Segments							
Road, I-270 to Geo[illegible], construct as 4 lanes + HO	$360	$0	$0	$360	$0	$360	$360
Road, US 29 to Prince George's County, construct as 4 lanes	$60	$0	$0	$60	$60	$60	$60
MD 28, Key West to Riffle Ford, widen to 4/6 lanes	$27	$27	$27	$27	$27	$27	$27
MD 97 Brookeville Bypass	$13	$0	$13	$13	$13	$13	$13
MD 118 Ext., MD 355 to M-83, construct as 6 lanes	$4	$4	$4	$4	$4	$4	$4
MD 119, Middlebrook to MD 124, widen to 6 lanes	$18	$18	$18	$18	$18	$18	$18
MD 12[illegible] Relocated, I-27[illegible] to MD 355, construct as 4 lanes	$10	$0	$0	$10	$10	$10	$10
MD 12[illegible] Relocated, MD [illegible]5 to A-83, construct as 4 lanes	$25	$0	$0	$25	$25	$25	$25
MD 124 [illegible] to Longd[illegible], widen to 6 la[illegible]	$4	$4	$4	$4	$4	$4	$4
MD 124 (Woodfield Rd e[illegible]), MD 108 to MD [illegible]7, construct as 2 lanes	$5	$5	$5	$5	$5	$5	$5
MD 355, Middlebr[illegible]k to MD 27, widen to 6 [illegible]nes	$26	$26	$26	$26	$26	$26	$26
MD 3[illegible], MD 27 to MD 1[illegible], widen to 4 lan[illegible]	$20	$0	$0	$20	$20	$20	$20
Briggs Chaney, Gateshead Manor to PG Co line, widen to 4 lanes	$9	$9	$9	$9	$9	$9	$9
Briggs Chaney, Realign at MD 650	$4	$4	$4	$4	$4	$4	$4
Brink/Wightman, MD 27 to Goshen, widen to 4 lanes	$44	$44	$44	$44	$44	$44	$44
Chapman Avenue, Bou to Executive, construct as 4 lanes	$65	$65	$65	$65	$65	$65	$65
Fairland Road, US 29 to Briggs Chaney, widen to 4 lanes	$6	$6	$6	$6	$6	$6	$6
Goshen Road, Girard to Warfield, widen to 4 lanes	$56	$56	$56	$56	$56	$56	$56
Midcounty Highway, Mont. Vill. to MD 121, construct as 4 lanes	$80	$0	$0	$80	$80	$80	$80
Montrose Parkway, I-270 to MD 355, construct as 4 lanes	$63	$63	$63	$63	$63	$63	$63
Nebel Street Ext, Randolph to Bou[illegible], construct as 4 lanes	$10	$10	$10	$10	$10	$10	$10
Norbeck/Spencerville Road, Georgia to US 29, widen to 4 lanes	$105	$105	$105	$105	$105	$105	$105
Shady Grove Road, MD 355 to Brian[illegible], widen to 6 lanes	$4	$4	$4	$4	$4	$4	$4
Snouffer School Road, Goshen to Centerway, widen to 4 lanes	$21	$21	$21	$21	$21	$21	$21
Watkins Mill Road, MD 117 to MD 355, construct as 4 lanes	$17	$17	$17	$17	$17	$17	$17
Interchanges							
I-270 @ Newcut Road	$15	$0	$0	$15	$15	$15	$15
I-270 @ Watkins Mill Road	$25	$0	$0	$25	$25	$25	$25
I-270 Spur @ MD 187	$14	$14	$14	$14	$14	$14	$14
I-270 Spur @ Democracy Boulevard/Fernwood Road	$14	$14	$14	$14	$14	$14	$14
US 29 @ Briggs Chaney	$24	$24	$24	$24	$24	$24	$24
US 29 @ Fairland or Musgrove Road	$19	$0	$19	$19	$19	$19	$19
US 29 @ MD 198/Blackburn	$37	$37	$37	$37	$37	$37	$37
US 29 @ Tech Road	$17	$0	$17	$17	$17	$17	$17
MD 117 @ MD 124	$20	$0	$0	$20	$20	$20	$20
MD 119 @ MD 28	$15	$0	$0	$15	$15	$15	$15
MD 119 @ Sam Eig	$15	$0	$0	$15	$15	$15	$15
MD 355 @ Gude	$20	$0	$0	$20	$20	$20	$20
MD 355 @ Montgomery Village Avenue	$20	$0	$0	$20	$20	$20	$20
MD 355 @ Montrose Road/CSX	$30	$0	$30	$30	$30	$30	$30
MD 355 @ Nicholson	$20	$0	$0	$20	$20	$20	$20
MD 355 @ Shady Grove	$20	$0	$0	$20	$20	$20	$20
MD 97 @ Randolph Road	$25	$0	$25	$25	$25	$25	$25
Intersections							
Randolph @ Connecticut	$2	$0	$2	$2	$2	$2	$2
Randolph @ New Hampshire	$2	$0	$2	$2	$2	$2	$2
Randolph @ Veirs Mill	$2	$0	$2	$2	$2	$2	$2
Other							
Four Corners Transit Center	$3	$3	$3	$3	$3	$3	$3
MARC North Bethesda Station	$3	$3	$3	$3	$3	$3	$3
Olney Transit Center	$1	$1	$1	$1	$1	$1	$1
Shady Grove West Transit Center	$4	$4	$4	$4	$4	$4	$4
Silver Spring Transit Center	$19	$0	$19	$19	$19	$19	$19
TOTALS		**$823**	**$1,291**	**$2,490**	**$3,172**	**$4,094**	**$2,814**

The primary differences among the roadway network portions of the alternatives can be attributed to three substantial roadway projects estimated to cost a combined $500 million:

- The western portion of the new road connecting I-370 to the Georgia Avenue or Layhill Road
- The Montgomery County section of the eastern portion of the road from US 29 to I-95 in Prince George's County
- The extension of Midcounty Highway from Montgomery Village Avenue to MD 121 in Clarksburg.

Combination Networks B, D, and the Recommended Plan also include busway and HOV network improvements. The establishment of an HOV lane (providing for bus movement as well) on the Montgomery County portion of the Capital Beltway is, at $550 million, one of the more expensive projects in the Recommended Plan. This is included in the plan since the completion of an HOV network on the County's congested Interstate highway system is critical to serving transit needs outside the rail-oriented activity centers.

- **Cost Effectiveness**

  An indication of cost effectiveness - improvements per unit of capital costs - is shown in **Table 4-7.** The left columns show the quantitative performance measures of the study goals. The center columns show the change in performance of the networks to the Base case, divided by the estimated capital costs (in billions of dollars). The right columns take the most efficient value for each measure and assign it a value of 100. The other values are then scaled against this. This is termed the efficiency index. The efficiency index has no real use for comparing one measure of effectiveness against another. Its usefulness lies in gauging the efficiency of each network - the cost per unit of improvement - against each other.

  The Recommended Plan is the most cost-effective means to increase accessibility and mobility. One of the trends observed in the review of mobility and accessibility measures of effectiveness is that the more expensive combination networks provide more superior performance than the lower cost networks. When normalized for capital cost, the Recommended Plan generally performs as well as the first or second best among the networks.

Table 4-7: Cost Efficiency Index

Measures of Effectiveness (MOEs)	Change From Base Divided by Capital Cost					Efficiency Index[1]				
	2020 Comb A	2020 Comb B	2020 Comb C	2020 Comb D	2020 Rec Plan	2020 Comb A	2020 Comb B	2020 Comb C	2020 Comb D	2020 Rec Plan
Capital Cost of Network (Billions)	$1.291	$2.490	$3.172	$4.094	$2.814					
Auto Mobility										
Average Speed (Miles/Hour)	-0.54	1.08	0.60	0.51	1.17	-46	92	51	44	100
Percent of Lane Miles Congested	-1.63	0.76	0.38	0.20	1.28	-127	60	30	15	100
Vehicle-Hours Traveled (VHT, thousands)	-5.42	3.61	2.52	1.47	4.62	-117	78	55	32	100
Transit Mobility										
Average Transit Travel Time (minutes)	3.95	4.90	4.04	3.54	4.83	81	100	82	72	99
Transit Accessibility										
Countywide Accessibility Index to Households (thousands)	8.52	10.04	10.72	10.26	11.73	73	86	91	87	100
Countywide Accessibility Index to Jobs (thousands)	14.72	18.47	23.01	18.08	21.32	64	80	100	79	93
Activity Center Accessibility Index to Households (thousands)	14.72	16.87	27.74	24.18	23.61	53	61	100	87	86
Percent of Jobs within 1/2 mile of Rail Stations	10.07	5.22	7.57	5.86	6.75	100	52	75	58	67
Percent of Households within 1/2 mile of Rail Stations	3.87	2.01	3.87	2.69	1.78	100	52	90	69	46
Auto Accessibility										
Countywide Accessibility Index to Households (thousands)	-46.48	30.12	1.89	19.30	35.89	-129	84	5	54	100
Countywide Accessibility Index to Jobs (thousands)	-24.01	22.09	-8.51	24.67	35.89	-67	62	-24	69	100
Activity Center Accessibility Index to Households (thousands)	-41.05	33.33	3.47	20.03	40.16	-102	83	9	50	100
Average Auto Travel Time (minutes)	-2.17	1.04	0.41	0.64	1.46	-149	72	28	44	100
Optimize Investment/Mode Share										
Transit Mode Share (percent of total)	0.77	1.08	0.91	0.81	1.07	71	100	84	74	98

[1]The best change from base/cost was set at 100 with all others rated relative to 100.

Mode Shares are included in **Table 4-1.** These are the percent of evening peak-hour trips made by the different modes or methods of travel. The Recommended and Network C are very similar, with about a 16% improvement in transit mode share over the Base conditions. The increase in future transit mode share is an important finding, since increasing the County-wide transit percent has proven to be a difficult task in past years. The forecasting process does not specifically model walk and bicycle trips, but provision of sidewalks, bicycle paths and lanes, and other supportive policies, can be expected to increase the use of these modes under any future network.

9. Year 2050 Evaluation

This section presents the evaluation of six combinations of future land use scenarios and transportation networks. The intent of this evaluation is to (1) examine the future demand for transitways and (2) to examine the differences that changes in land use patterns would have on transportation demand.

- **Land Use Scenarios and Transportation Networks**

  The number of households and jobs in the Year 2050 scenario was determined as a straight line projection by multiplying the forecasted growth between the Years 2015 and 2020 by six and adding that number to the Year 2020 forecast. The result was a total of approximately 480,000 households and approximately 750,000 jobs. These numbers were held constant in the scenarios so that the effect of the land use distribution could be determined. The land use scenarios were developed in order to compare the effect of different land use patterns on the use of transportation facilities and services. The three scenarios are shown in **Figures 4-12, 4-13,** and **4-14.** These figures are comparable to **Figures 1-8, 1-9,** and **1-10.**

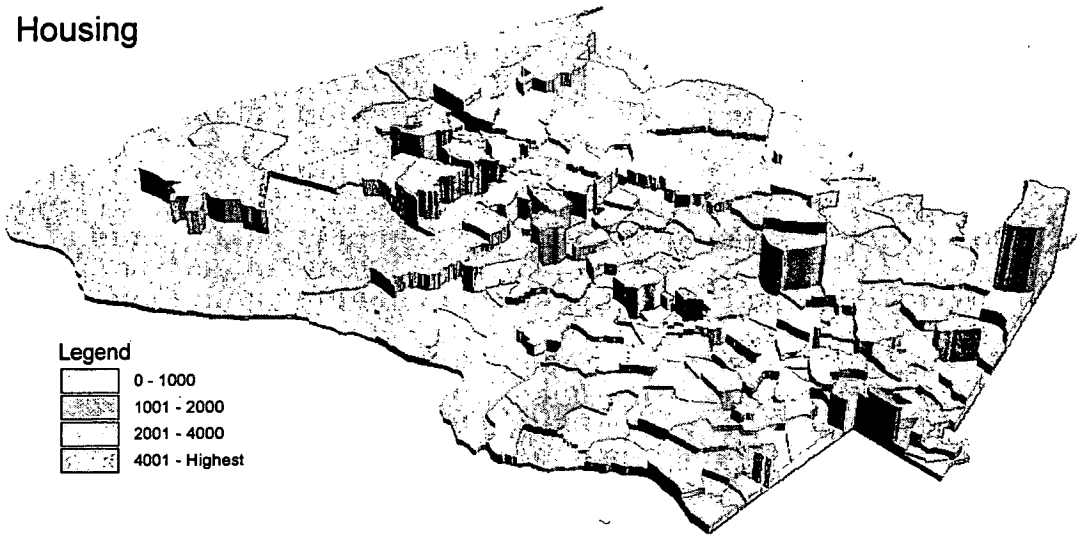
  The Master Plan Scenario included the land use pattern anticipated by the build-out of the approved area master plans by the Year 2050. In order to achieve comparability, the number of employees in the Master Plan Scenario was limited to 750,000, the same number as anticipated by the Year 2050 in the other two scenarios.

  The Transit-Focused scenario focused on future development in areas within walking distance of the master planned transit stations. The resulting densities in those areas were increased to levels up to 25% beyond those in the currently approved master plans.

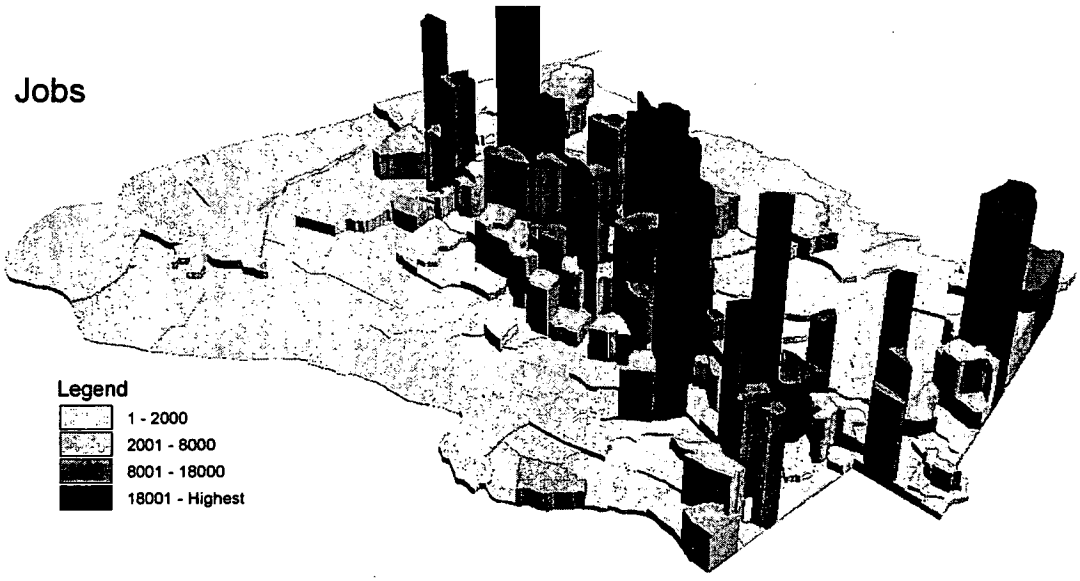
Master Plan Scenario
(Housing and Jobs in the Year 2050 by Traffic Zones*)

Figure 4-12

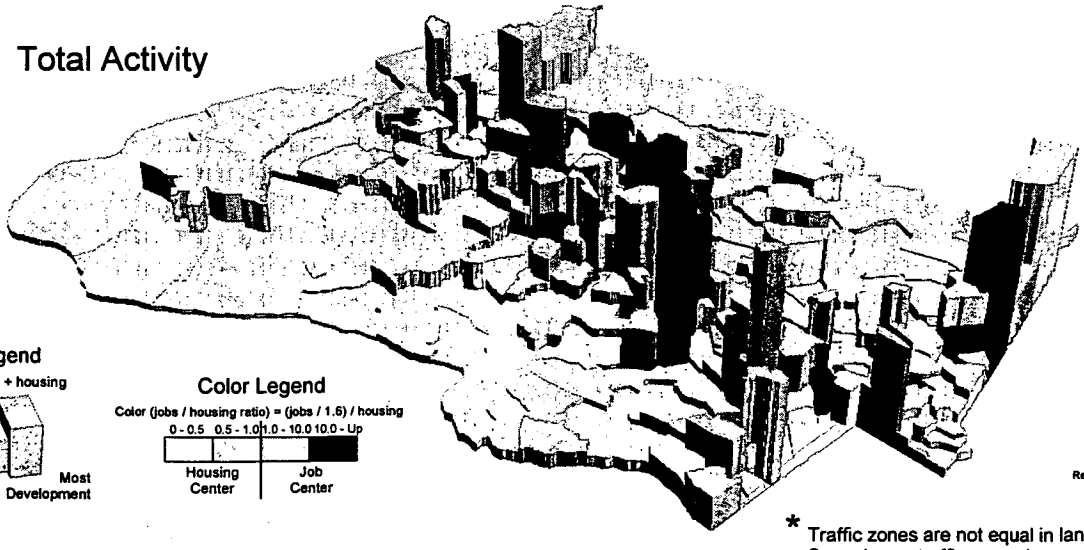
Housing



Jobs



Total Activity



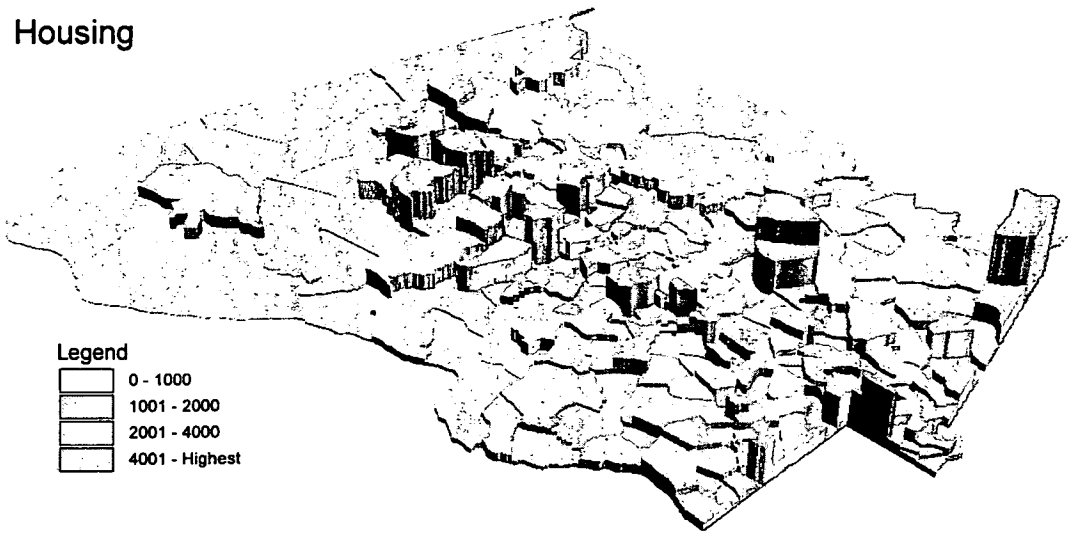
Research & Technology Center

* Traffic zones are not equal in land area. Some larger traffic zones have a high total number of jobs or housing (such as the high housing on the north east side of the county). These are not maps of development density.

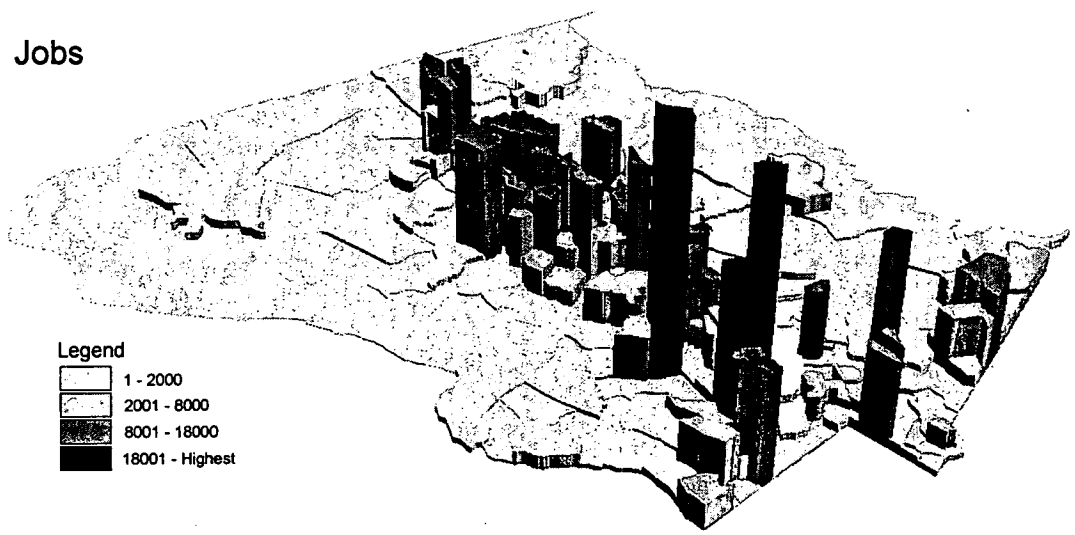
Transit - Focused Scenario
(Housing and Jobs in the Year 2050 by Traffic Zones*)

Figure 4-13

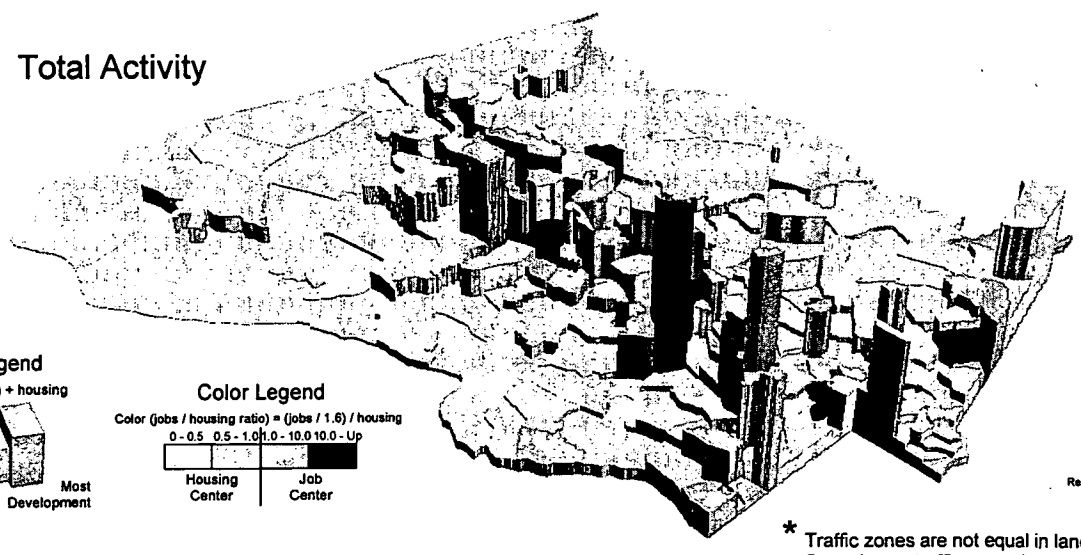
Housing



Jobs



Total Activity



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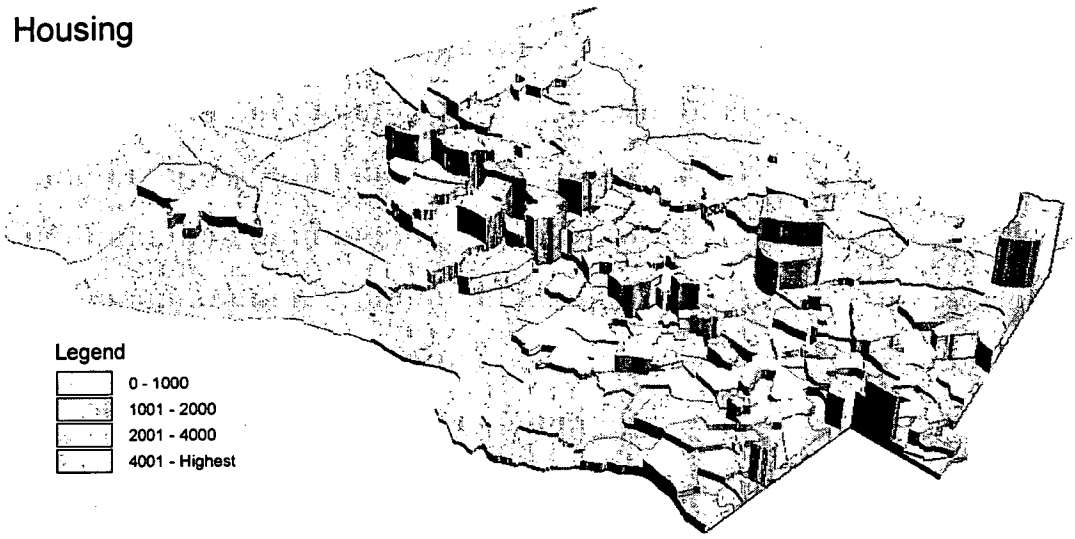
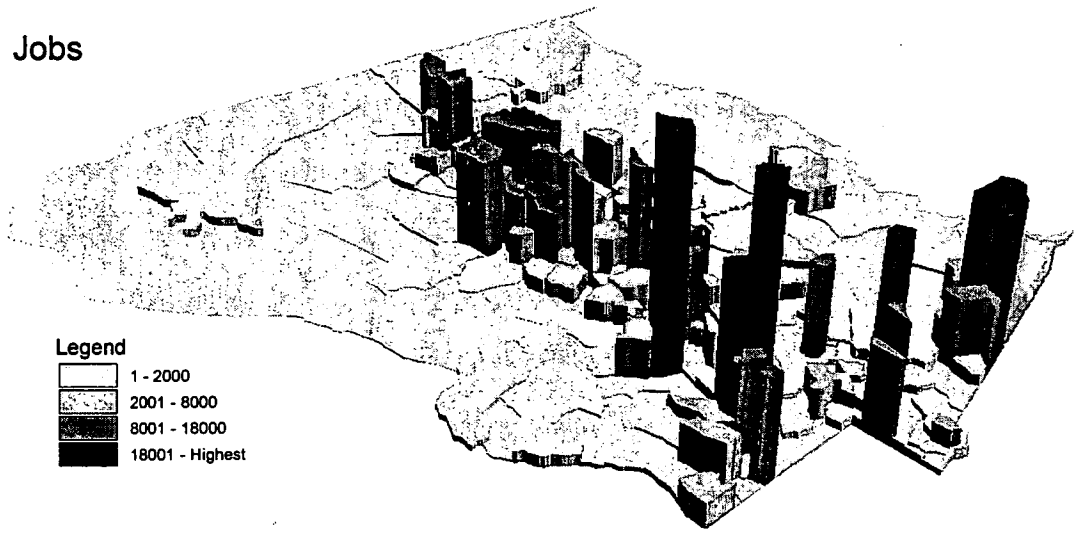
Locally Balanced Scenario (Housing and Jobs in the Year 2050 by Traffic Zones*)

Figure 4-14

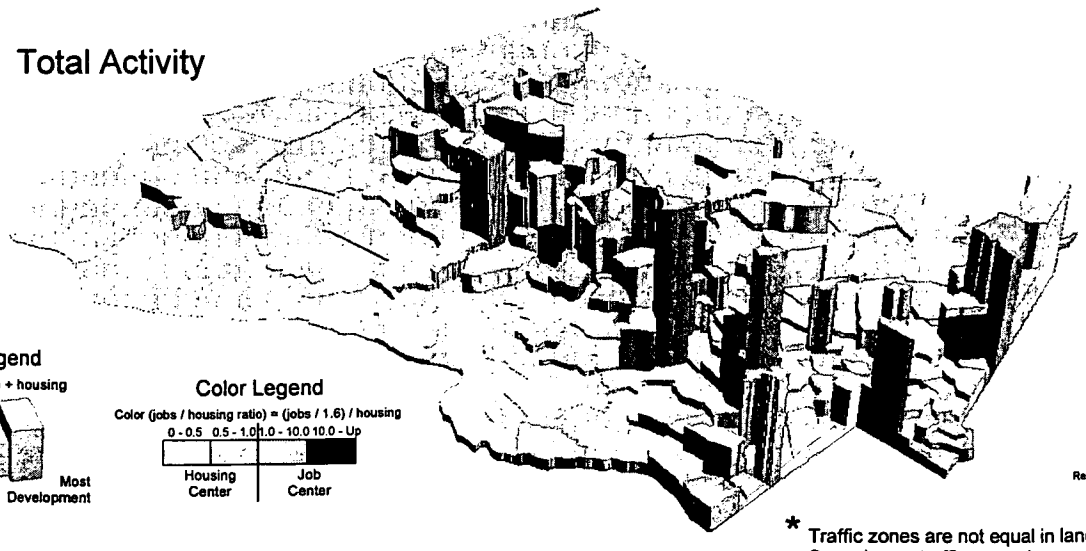
Housing



Jobs



Total Activity



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* Traffic zones are not equal in land area. Some larger traffic zones have a high total number of jobs or housing (such as the high housing on the north east side of the county). These are not maps of development density.

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The Locally Balanced scenario focused development within walking distance of transit stations and, in addition, balanced the number of jobs and employed residents in the two major radial development areas -- along I-270 and along US 29. This scenario was developed by members of the Project Advisory Team and the Citizens Planning Association.

The approach to developing the land use patterns in the three scenarios are different and these differences are reflected in the Figures. The clearest differences which can be seen are:

Housing

In the Gaithersburg area, the Master Plan scenario has the least intensity of housing and the Locally Balanced scenario has the most

Housing development in the Poolesville and wedge areas is reduced in both the Transit-Focused and the Locally Balanced scenarios in comparison to the Master Plan scenario

Additional residential development has been placed in Friendship Heights Bethesda, and Silver Spring beyond that in the Master Plan scenario

Jobs

More employment is focused in the I-270 Corridor south of Clarksburg in the Transit-Focused and Locally Balanced scenarios than in the Master Plan scenario

There are differences in the number and distribution of jobs along US 29 in the three scenarios

Total Activity

There are more high-intensity housing centers in the I-270 Corridor in the Transit-Focused and Locally Balanced scenarios than in the Master Plan scenario

The Locally Balanced scenario has the fewest zones with the maximum range of jobs-to-housing ratios, with the Transit-Focused scenario being second.

Table 3-2 indicates the combinations of land use patterns and transportation networks evaluated. Each of the three scenarios have been evaluated with a Master Plan Network -- the full transportation network in the County's area master plans. The Master Plan and the Transit-Focused Scenarios also have been tested with Enhanced Network #1 -- a more extensive network which includes a transitway on US 29 and the transitways in the Capital Beltway MIS, both inside and outside the Beltway. The Locally Balanced scenario was tested with Enhanced

Network #2 which adds to Enhanced Network #1 four additional transit stations to serve new activity centers included in that scenario.

- **Evaluation of Combinations**

Table 4-8 compares the effectiveness of the Master Plan and the Locally Balanced scenarios. The results of the evaluation of the Transit-Focused scenario placed it between the other two. For each of the scenarios, the number represents the network. The number '1' represents the Master Plan transportation network and the number '2' represents the Enhanced network. For reference, the results for the 1998 Base and the Year 2020 (CLRP) Base are also included.

The major conclusion is that land use patterns **do** make a difference in the demands on transportation networks. Specifically, the Locally Balanced scenario achieves significantly greater transportation benefits than the Master Plan scenario when each is evaluated with the same transportation network. For all of the measures of effectiveness tested with both the transportation networks, the Locally Balanced scenario is more effective.

For each measure of effectiveness, the difference between the two scenarios when compared for each transportation network varies by four percent or less. For example, the Activity Center to Households Accessibility Index is eight percent higher for the Locally Balanced scenario than for the Master Plan scenario with the Master Plan transportation network; with the Enhanced network, the Locally Balanced scenario is ten percent higher. This comparability of the relative differences is another indication that the improvements are caused by the land use pattern and not by the transportation network.

Even with the Enhanced network (Number '2' on **Table 4-8**), neither of the Year 2050 scenarios consistently achieves as high a rating as the Recommended Year 2020 Network. The Recommended Year 2020 Network does better in the areas of Auto Mobility and Auto Accessibility, whereas the Year 2050 scenarios tend to do better in the Transit measures. As discussed below, the Recommended Year 2020 Network is more effective in terms of auto measures whereas the Year 2050 scenarios tend to be better in terms of transit measures.

Table 4-8: Comparison of 2050 Alternatives (Land Use Scenarios and Networks)

Measures of Effectiveness (MOEs)	1998 Base	2020 Base	2050 Locally Balanced 1	2050 Locally Balanced 2	2050 Master Plan 1	2050 Master Plan 2
Auto Mobility						
Total Lane-Miles	2,472	2,606	3,014	2,792	3,014	2,792
Vehicle-Miles Traveled (VMT, thousands)	1,446	1,814	2,056	1,986	2,172	2,116
Vehicle-Hours Traveled (VHT, thousands)	55	102	126	101	166	135
Average Speed (Miles/Hour)	26.1	17.7	16.4	19.7	13.1	15.6
Percent of Lane-Miles Congested	9.7%	20.6%	22.9%	21.7%	27.4%	26.7%
Transit Mobility						
Number of Transit Boardings (thousands)	66.5	100.3	204.7	224.9	182.3	208.1
Bus	30.6	58.4	78.5	82.0	73.3	75.6
Rail	35.9	41.9	126.2	142.9	109.0	132.5
Transit Accessibility						
Countywide Accessibility Index to Households (thousands)	98	104	168	193	139	164
Countywide Accessibility Index to Jobs (thousands)	182	194	321	384	265	329
Activity Center Accessibility Index to Households (thousands)	155	162	247	338	228	308
Percent of Jobs within 1/2 mile of Rail Stations	40%	37%	66%	73%	54%	59%
Percent of Households within 1/2 mile of Rail Stations	13%	15%	33%	37%	21%	26%
Average Transit Travel Time (minutes)	55.9	60.4	48.2	43.9	50.8	46.0
Auto Accessibility						
Countywide Accessibility Index to Households (thousands)	546	647	740	745	607	626
Countywide Accessibility Index to Jobs (thousands)	423	1,134	1,207	1,354	1,073	1,196
Activity Center Accessibility Index to Households (thousands)	195	658	768	753	660	654
Average Auto Travel Time (minutes)	26.0	35.2	36.8	32.6	41.6	37.6
Mode Share						
Transit	17.5%	18.6%	26.1%	26.5%	23.8%	24.6%
Single-Occupancy Vehicle (SOV)	70.7%	67.9%	59.2%	58.4%	62.5%	61.5%
High-Occupancy Vehicle (HOV)	7.8%	7.6%	6.6%	6.5%	7.0%	7.0%
Walk/Bike	4.0%	5.8%	8.2%	8.5%	6.7%	6.9%

- **Mobility**

  None of the four Year 2050 combinations shown on **Table 4-8** bring the auto mobility measures back to the levels of the Year 1998 Base. Only for average speed do any of the Year 2050 scenarios do better than the Year 2020 Base or the Recommended Year 2020 Network. The Locally-Balanced scenario, however, results in levels comparable to or better than those of the Year 2020 Base.

  In particular, that scenario results in a 6% lower level of Vehicle-Miles Traveled on the Master Plan Network than the Master Plan Scenario. Comparisons of the same two combinations indicate a 32% lower level of Vehicle-Hours Traveled and an 25% higher average speed for the Locally-Balanced scenario. The number of congested lane miles are also 20% lower with the Locally Balanced Scenario. Comparable or stronger results are found when the Enhanced Network is used with those two land-use scenarios.

- **Accessibility**

  Again, the Locally Balanced scenario ranks higher than the Master Plan scenario. Comparing the evaluation ratings for the Master Plan Network (Number '1' on **Table 4-8**) the Locally Balanced scenario receives a rating 21 percent higher than for the Master Plan scenario for both the Transit County-wide Household and Jobs Accessibility Index. In terms of Auto Accessibility, the comparable figures are 22 percent higher for Household accessibility and 12 percent for Job accessibility. With the Enhanced Transportation Network, the figures are similar.

  For Transit Accessibility, only in terms of Average Travel Time do the Year 2050 scenarios not do better than the Recommended Year 2020 Network.

- **Mode Share**

  The Locally Balanced scenario produces a higher transit mode share than the Master Plan scenario with both transportation networks. In all four combinations of land use and transportation networks, the transit mode share is higher than that of the Recommended Year 2020 Network.

10. Details on Environmental Review

- **Background/Introduction**

The County-wide Planning Division reviewed the TPR alignment alternatives to identify significant impact issues. These alignments are as described in **Chapter III.** The purpose of this review was to identify the location and nature of important environmental/natural resource concerns and to determine their degree of impact or significance on project development. Proximity to historic sites was also identified. This information could be used, in part, in alternative selections, priority setting and alignment shifts. All identified concerns or issues will require special attention in the pursuit of any project development.

- **Process**

A team of County-wide Planning staff worked together to develop a strategy to evaluate and present impact information at a general level in a short time frame. The Geographic Information System (GIS) was employed to examine the TPR alignment alternatives relative to natural and environmental features.

The alignments were refined to show the respective sections that are:

- below grade (ground) level
- at-grade along existing transport facilities
- at-grade on undisturbed/new rights-of -way

These categories are associated with generally increasing degrees of impact from least for underground sections, to most for newly-disturbed locations.

The team worked together through each alignment, identifying and noting locations and type of concern. This iterative process lead to consensus on general categories of concern which were symbolically noted by location on the working GIS base map.

- **General Categories of Concern**

- Forest Fragmentation – crossing of contiguous forest of 100 or more acres
- Significant Wetland/Flood plain Impact – proximity to or crossing of known Flood plain and wetlands
- Park Crossing – crossing of existing or proposed parkland
- Longitudinal Stream Impact – proximity along or parallel to a stream
- Modified Stream Crossing – crossing a stream at an existing crossing location
- New Stream Crossing – crossing a stream at a new location

- Bio-diversity Area – proximity to an area with significant natural communities[1]

The team next discussed and identified the locations of unique and significant features which required some further description or detail. The resulting product was a working map showing all locations and general types of resource impact/concern and further highlights for unique or significant features and concerns.

A separate review of historic resources identified locations where alignments are next to or cross designated sites is found later in this Chapter.

- **Evaluation Results**

There were nine areas of significant environmental/natural resource concerns identified. These locations are identified on a GIS display map (see **Figure 4-15**) and are generally described in the following list:

1. I-270 through Clarksburg – The northern section of this transit route goes through a special protection area (SPA). These are areas designated to protect and maintain high-quality or sensitive water resources[2]. Project development would need to have significant focus in alignment location and design, to ensure preservation of environmental buffer areas, to minimize stream crossings, and to have environmentally sensitive design throughout.

2. I-270 at Great Seneca – Major construction in the watershed which drains into Little Seneca Lake will add additional sedimentation to Little Seneca Creek, Cabin Branch and the lake. Considerable efforts should be made to prevent as much of this sedimentation as possible.

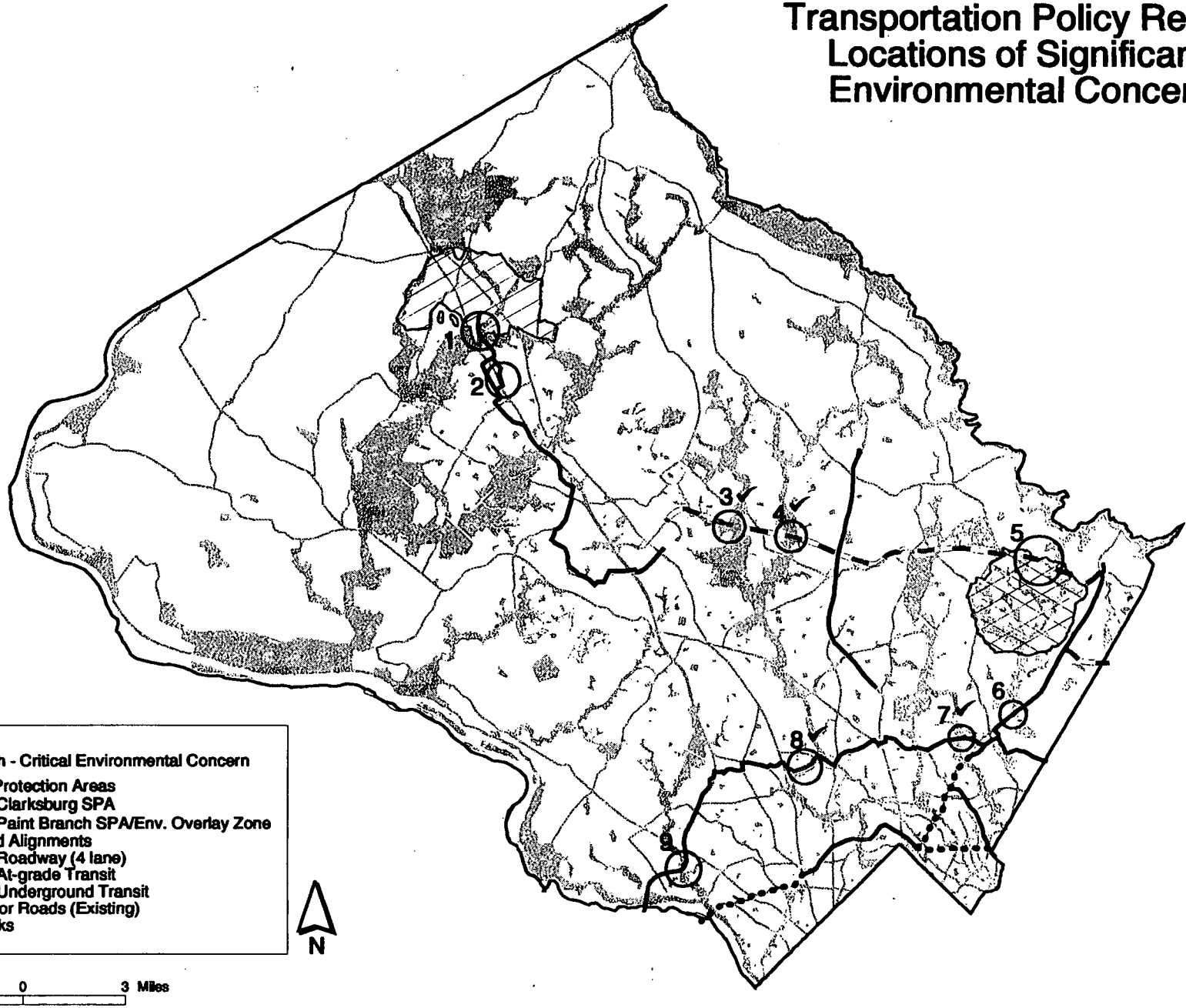
---

[1]Biodiversity areas are defined in the *Park, Recreation, and Open Space Master Plan* as significant natural communities that enhance the biodiversity of the County. These areas contain one or more of the following natural resources:

1. Populations of rare, threatened, endangered, or watchlist plants or animals.
2. Unusual or unique types of habitat.
3. Examples of high quality or otherwise significant natural communities.
4. Plant or animal species with importance to the County or locality.

[2]SPA – "A Special Protection Areas is a watershed or part of a watershed where (1) existing resources, or other environmental features directly relating to those water resources, are of high quality or unusually sensitive; and (2) proposed land uses would threaten the quality or preservation of those resources or features in the absence of special water quality protection measures which are closely coordinated with appropriate land use controls. Designation of an SPA is done by the County Council."

Transportation Policy Report
Locations of Significant Environmental Concern



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3. ICC crossing of Rock Creek/Mill Creek - The route follows along Mill Creek through the Needwood North Bio-diversity area, an area of at least eight species of rare, threatened, endangered and watchlist species. Contiguous forest land would be fragmented reducing forest interior bird habitat. Stream impact issues include increased sedimentation in the stream and Needwood Lake, stream water warming and destructive stream flow alteration. Many of the wetlands within Mill Creek stream valley have recently been preliminarily identified as high priority wetlands (with respect to function and value) as part of a planning level inventory conducted in the upper Rock Creek watershed. The wetlands inventory is part of a larger inventory documenting and assessing the extent and quality of various environmental resources in upper Rock Creek in preparation for the forthcoming Upper Rock Creek Mater Plan amendment work.

4. ICC crossing of North Branch - The alignment crosses the North Branch Bio-diversity area, within one of the best natural areas in the County, including unique, high quality, wetland communities. The alignment would fragment the large, contiguous forest area, impacting 150 acres of forest interior habitat. The environmental impacts to this area are outlined in much more detail in the ICC-DEIS and related staff review reports.

5. MD 198 through Paint Branch SPA - Construction along Spencerville Road will directly impact the upper Paint Branch watershed and will be within an SPA. Project development would need to address site imperviousness limits as well as other SPA requirements. If project limits extend outside the MD 198 right-of-way limits (including SWM facilities), there will most likely be significant new stream and park crossing impacts. It was also noted that this segment is located in part of the Right Fork tributary which has the area's highest water quality.

6. US 29 at Paint Branch - The Paint Branch Bio-diversity area lies on both sides where US 29 crosses Paint Branch. Watchlist plants have been identified on both sides of US 29 in this area. The proposed transit line could have a significant impact if placed on the south side of US 29, therefore the specific alignment will be critical through this area.

7. Northwest Branch crossing between US 29 and University Boulevard - crosses directly through the Northwest Branch Bio-diversity area which is part of one of the best natural areas in Montgomery County. Rare, threatened and endangered plants in this area could be impacted.

8. Rock Creek Park (Grosvenor to Kensington) – The proposed route crosses Rock Creek directly through the Pooks Hill Bio-diversity area, and follows the stream valley for quite some distance. Pools in forested flood plains and wetlands which offer ideal habitat for amphibians and reptiles will be impacted in this area, and there will likely be adverse impacts on the stream habitat and aquatic life downstream as well. Watchlist plants identified in this area could be affected.

9. Cabin John at I-495 – The Clara Barton Bio-diversity area, which is one of the best quality natural areas in the County, lies just south of where the Beltway (and proposed transit route) crosses Cabin John Creek. If the transit line is developed south of the Beltway, this area may be adversely impacted.

The locations and concerns described above indicate what particular or special attention will be necessary and most significant to address if and when projects are moved forward for approval and design. Staff has further rated the relative degree of likely impact in these areas. Based on this assessment, staff identified four areas where the significance of concern is critical and the potential impacts are sufficient to require consideration of alternative alignments, alignment shifts or mitigation. These four areas are locations 3, 4, 7, and 8 as described above. The following **Table 4-9** tabulates the staff assessment of the likely degree of relative impact of all locations and highlights the critical concerns.

Table 4-9: Staff Assessment of Relative Impact

LOCATION (see map, figure 1)	IMPACT RATING	CRITICAL FACTORS
1	Higher	
2	Medium	
3	High-Critical	-Bio-diversity Area/RTE -High Quality Wetlands -Significant Forest Fragmentation -Sedimentation
4	High-Critical	-Bio-diversity Area/RTE -High Quality Wetlands -Forest Fragmentation
5	Higher	
6	Lower	
7	High-Critical	-Bio-diversity Area/RTE -High Quality Natural Area
8	High-Critical	-Wetland of Special State Concern -Bio-diversity Area/RTE
9	Lower	

Locations 3 and 4 were extensively evaluated as part of the ICC draft EIS and subsequent Planning Board review in 1997. **Table 4-10** provides a summary of staff, Board and federal agency positions regarding these locations in 1997 as well as other more recent information. The positions reported in Table 2 are based on a current staff interpretation of the record of positions established in 1997 during the ICC DEIS review process. There are no options to the North Branch crossing (location 4) and its design must include mitigation of the unavoidable impacts. The options to the Rock Creek crossing (location 3) are either connecting Midcounty highway extended, across Rock Creek, or following the "Rock Creek Partial Avoidance Option," which connects from the end of I-370 through Cashell Estates to Midcounty Highway and across Rock Creek to the north. The option through Cashell Estates would take 11 of 22 homes and literally divide and severely impact the current Cashell Estates community.

Locations 7 and 8 have also been identified as High-Critical due to their location across parkland and their related resource impacts. Capper-Crampton funds were used to purchase park property at Location 8. In that regard, any proposed project must be approved by the National Capital Planning Commission.

- **General Concern on Wildlife Conflicts**

  All modified and new stream valley crossings should be designed to allow adequate space for wildlife to pass under the proposed crossing. Fencing should be used to direct deer and other wildlife to these safe crossings. Long stretches of roadway and light rail lines must also be fenced, and vegetation used in landscaping should be limited to prevent luring the deer onto them for food.

11. Identification of Potential Historic Resources Impacts

Staff has identified 22 sites designated on the Montgomery County Master Plan for Historic Preservation, including six historic districts, that may be impacted by the proposed transportation alignments. The potential for adverse effects on the sites should be evaluated in all further studies. Investigation of all archeological sites along the alignments should be included as an integral part of any alignment development.

The historic resources along the proposed alignments fall into two categories:

Those that were included in the earlier ICC-Draft EIS cultural resources evaluation. The potential negative impacts are reviewed in that document.

TABLE 4-10: HIGH-CRITICAL DEIS LOCATIONS

Master Plan Alignment

LOCATION	1997 Staff Proposal Presented to MCPB	1997 MCPB Proposal Sent to MCC	1997 DEIS Corps of Engineers Position[3]	1997 DEIS EPA[4] Position	Additional Information Since 1997[5]	Options Available
3 - Rock Creek	Not Accepted	Accepted	"Workable"	EO - Environmental Objections	Yes	Road Shift and Mitigation
4 - North Branch	Accepted with Significant Environmental Impact	Accepted	Acceptable	EC - Environmental Concerns (Midcounty Alternative)	Yes	Unavoidable Impacts, Mitigation Only

[3]Staff interpretation of Corps of Engineers letter of position on DEIS alternatives.

[4]EPA rating system applies to entire alternative, not specific locations within an alternative.

EO: Environmental ***Objections***

The EPA review has identified significant environmental impacts that ***must be avoided*** in order to provide adequate protection for the environment. Corrective measures may require substantial changes to the preferred alternative or consideration of some other project alternative (including the no action alternative or a new alternative). ***EPA intends to work with lead agency to reduce these impacts.***

EC: Environmental ***Concerns***

The EPA review has identified environmental impacts that ***should be avoided*** in order to fully protect the environment. Corrective measures may require changes to the preferred alternative or application of mitigation measures that can reduce the environmental impact. ***EPA would like to work with the lead agency to reduce these impacts.***

[5]Attachment #3: "Findings of Functional Assessment of Wetlands in Upper Rock Creek Relative to the ICC Master Plan Alignment." July 30, 1999.

15/51	Drayton	16100 Oak Hill Road, Spencerville
15/52	Edgewood II	16101 Oak Hill Road, Spencerville
15/55	Spencer/Carr House	2420 Spencerville Road, Spencerville
15/59	Bennett/Allnutt House	2708 Spencerville Road, Burtonsville
23/115	Willow Grove	16301 Batchelor's Forest Rd, Olney
23/113	Norbeck HD/White Hardware (not MP)	Georgia & Norbeck, Rockville

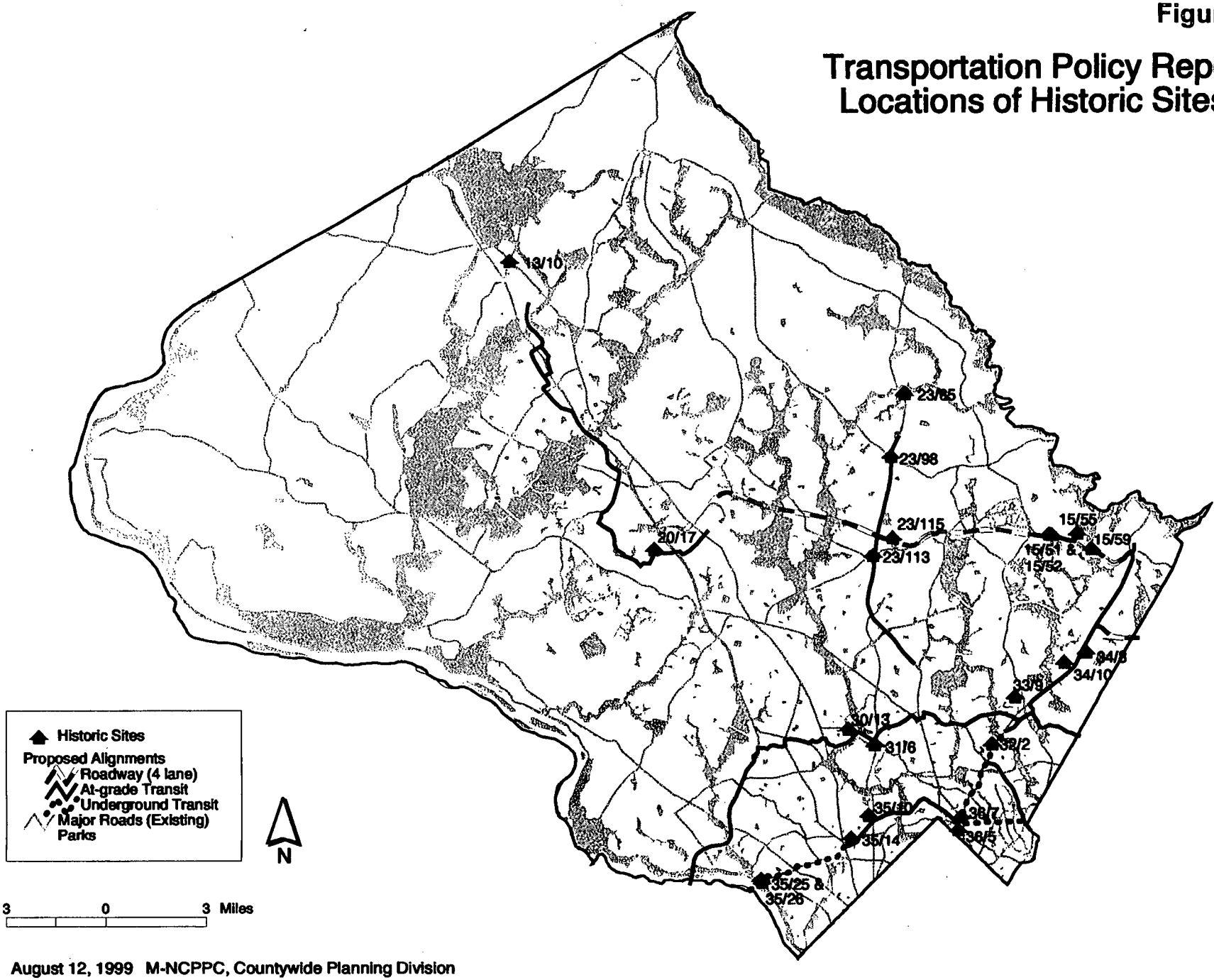
Those that are potentially affected by the other alignments shown on **Figure 4-16.** These alignments have not yet been studied as to their impact on historic sites. The degree of adverse impact, if any, will be reviewed as the plans for the alignments are developed with more specificity.

35/25	Clara Barton House	5801 Oxford Road, Bethesda
35/26	Glen Echo/Chautauqua HD	Glen Echo
35/14	Bethesda-Chevy Chase HS	4301 East West Highway, Bethesda
35/10	Hayes Manor	4101 Manor Road, Bethesda
36/5	Acorn Park/Silver Spring	Blair Mill Road, Silver Spring
36/7	Silver Spring Resources	Colesville/Georgia Avenues, Silver Spring
32/2	Holly View	10400 Colesville Road, Silver Spring
33/9	Quaint Acres/Shaw House	709 Quaint Acres Drive, Silver Spring
32/3	Read House	503 Dennis Avenue, Silver Spring
31/6	Kensington Historic District	Connecticut Avenue, etc. Kensington
30/13	Garrett Park Historic District	Garrett Park
34/10	Conley House/Green Ridge	12500 Columbia Pike, Silver Spring
34/8	Julius Marlowe House	2525 Musgrove Road, Silver Spring
20/17	England-Crown Farm	9800 Fields Road, Rockville
21/6	Kentlands	Kentlands, Gaithersburg
19/19	Grusendorf Log House	13313 Clopper Road, Gaithersburg
13/10	Clarksburg Historic District	MD 355 at MD 121
10/59	Hyattstown Historic District	MD 355 at MD 109
23/98	Olney House (and other Olney resources)	MD 108 at Georgia Avenue
23/65	Brookeville Historic District	Georgia Avenue at Brighton Dam Road

Also: C & O Canal National Historical Park

Figure 4-16

Transportation Policy Report
Locations of Historic Sites



August 12, 1999 M-NCPPC, Countywide Planning Division

Appendices

Transportation Policy Report

August, 1999

Appendices

Appendix A
Glossary of Terms and List of Acronyms

List of Acronyms

ADT	Average Daily Traffic
AGP	Annual Growth Policy
BRT	Bus Rapid Transit
CBD	Central Business District
CLRP	Constrained Long Range Plan
CTP	Consolidated Transportation Program
DEIS	Draft Environmental Impact Statement
EPA	Environmental Protection Agency
FDA	Food and Drug Administration
GIS	Geographic Information System
HOV	High Occupancy Vehicle
ICC	Intercounty Connector
ITS	Intelligent Transportation System
LRT	Light Rail Transit
MARC	Maryland Commuter Rail
MC	Montgomery County
MCC	Montgomery County Council
MCPB	Montgomery County Planning Board
MCPPD	Montgomery County Park and Planning Department
MDOT	Maryland Department of Transportation
MIS	Major Investment Study
MOE	Measures of Effectiveness
MP	Master Plan
MPBO	Master Plan Build Out
MWCOG	Metropolitan Washington Council of Governments
NEPA	National Environmental Policy Act
PAT	Project Advisory Team
RTE	Rare, Threatened and Endangered plant or animal species
SHA	State Highway Administration
SPA	Special Protection Areas
SWM	Storm Water Management
TAZ	Traffic Analysis Zone
TPR	Transportation Policy Report
TSG	Transportation Solutions Group
TWG	Technical Work Group
VDOT	Virginia Department of Transportation
WMATA	Washington Metropolitan Area Transit Authority

Glossary

Accessibility: A measure used in evaluating a transportation network's effectiveness. Accessibility is based on the number of opportunities (home or jobs) a person can reach within a certain amount of time beginning in specified locations. The more reached, the greater the accessibility. Accessibility is usually measured by specific mode: driving alone or taking transit. (See SOV Accessibility, Transit Accessibility.)

Accessibility Index: See Household Accessibility Index and Job Accessibility Index.

Activity Center: Concentration of housing and/or jobs in a relatively small area of the county.

Alignment: A road or stretch of land being evaluated for use as a transitway or HOV facility. At the Transportation Policy Report level of analysis, the description of an alignment does not include its exact location along its associated roadway or right-of-way.

Annual Growth Policy (AGP): A policy document adopted annually by the County Council intended to facilitate and coordinate government's powers in limiting or encouraging growth and development in the County within master plan and zoning limits. The overall purpose of the AGP is to match the timing of private development with the availability of public funds.

Average Daily Traffic: The total volume of auto and truck traffic passing a given point during an average weekday (24 hours). A commonly used measure of traffic flow.

Average Speed: An average of forecast peak-hour travel speeds throughout the county, weighted by traffic volume. This measure is calculated by dividing vehicle miles of travel by vehicle hours of travel.

Average Travel Time: An estimate of the average time for a transit and auto trip taken in the future to reach jobs and households in the evening peak period.

Bio-diversity Areas: Areas that are defined in the *Park, Recreation and Open Space Master Plan* as significant natural communities that enhance the Bio-diversity of the county. These areas contain natural resources such as: population of rare, threatened, endangered or watchlist plants or animals; unusual or unique types of habitat; examples of high quality or otherwise significant natural communities; plant or animal species with importance to the county or locality.

Bus Rapid Transit: Buses operating on special or restricted roadways providing high quality service with many of the features of rail rapid transit systems such as: vehicles unimpeded by traffic signals and congestion, fare collection prior to boarding, quick passenger loading and unloading at stations and efficient and reliable service.

Busway: A facility devoted entirely to buses; can either be dedicated bus lane(s) in a road's right-of-way or an entirely separate right-of-way. A preferential roadway designed for exclusive use by buses and located either in a separate right-of-way or within a freeway right-of-way.

Centroid: The presumed locus of activity and actual point of trip production or attraction in the center of a traffic analysis zone (TAZ), regardless of whether or not TAZ activity is actually generated there.

COG: See Metropolitan Washington Council of Governments.

Collector-Distributor Lanes: On freeways, lanes intended for shorter trips (involving less than three interchanges) and for entering and exiting the main highway.

CLRP (Constrained Long-Range Plan): The financially Constrained Long-Range Plan identifies transportation projects and strategies which can be implemented by 2010 and by 2020 within financial resources reasonably expected to be available and which comply with Federal requirements for financial constraint and air quality conformity.

DEIS (Draft Environmental Impact Statement): See Major Investment Study.

Destination Choice: See Trip Distribution.

Development Capacity Index: A measure used to determine an alternative network's support for expected growth. It is obtained by calculating the increase in average household accessibility from defined activity centers, weighted by the amount of forecast jobs in that area. It is then rated, with the best network scoring 100 and the rest scaled accordingly.

DOT(Department of Transportation): See Maryland Department of Transportation

Efficiency Index: A measure used to gauge the benefit-to-cost ratio of each network in improving the county's transportation system. The index shows the change in performance of each alternative network (relative to the 2020 Base network) divided by the estimated capital cost.

Feedback: The application of congested travel times in the travel demand model, such that congested travel times on the highway network are fed back to trip distribution and mode choice to estimate demand. This procedure is used in the TRAVEL/2 model to provide a more realistic representation of how travel patterns change in response to congested conditions.

Guideway (Fixed Guideway): The right-of-way plus the special improvements required for operations, such as tracks, power distribution, control systems.

Headway: A determinant of the frequency of service: a two-minute headway means a transit vehicle arrives at a station every two minutes.

Heavy Rail Transit: Urban transportation system noted for high speeds (up to 70mph), the existence of a third rail, or the electrified rail from which the vehicles draw their power, and high people-moving capacity. Often underground and know as the subway. Pedestrians cannot cross the tracks except via an entirely separate facility such as an underpass or footbridge. A local example is the Metrorail system.

High-Occupancy Vehicle (HOV)/Bus Lanes: A form of preferential treatment in which lanes on streets or highways are restricted for the exclusive use of high-occupancy vehicles (a vehicle with a specified minimum number of occupants--often two or three) and buses for at least a portion of the day.

Household Accessibility Index: A measure of effectiveness used to determine the quantity of households that can be reached within 45 minutes from jobs via transit or auto. Household Accessibility Index for activity centers is obtained by dividing the total number of potential new jobs-to housing matches by the total number of jobs in the activity centers. The same process is used to calculate indices for the countywide accessibility, only instead of activity centers numbers, countywide values are used.

Intersection Control: A traffic control device, such as a signal or stop sign , used to assign right-of-way to drivers and facilitate the orderly and predictable movement of traffic at intersections.

Job Accessibility Index: A measure of effectiveness used to determine the quantity of jobs that can be reached within 45 minutes from households in a specified location via transit or auto. Job Accessibility Index is obtained by dividing the total number of potential new households-to employment matches by the total number of households in the county.

Light-Rail Transit (LRT): An urban transportation system that uses electrically powered rail cars operating singly or in short trains on fixed guideways. It may be grade separated, and passengers can board from low- to medium-height platforms. The speed is somewhat less than heavy rail transit, but because it does not use a potentially dangerous third rail for power, it can run on city streets and pedestrians can easily cross the tracks. A local example is the Baltimore Central Light Rail.

Links: Segments of highway system represented in a digital map called a network used by the travel demand model. (See Nodes.)

Major Investment Study and Draft Environmental Impact Statement: A description and summary of potential transportation and environmental impacts, costs, and a comparative evaluation of transportation improvements being considered. It includes a comprehensive evaluation of the transportation alternatives and provides a basis for selecting a preferred alternative. It provides information about the likely impacts and consequences of alternative transportation investment strategies for local, regional, and state decision makers.

MARC: The Maryland Rail Commuter Service operated by MDOT operates three lines, two to Baltimore and points north (Camden and Penn) and one through Montgomery County to West Virginia (Brunswick). Commuter rail is normally used for longer journeys and connects the outer suburban areas to the urban districts. Stations are generally far apart and the trains travel up to 70 mph.

Maryland-National Capital Park and Planning Commission (M-NCPPC): A bi-county agency created by the General Assembly of Maryland in 1927. The Commission has three major functions: (1) the preparation, adoption and occasional amendment or extension of the General Plan for the physical development of the Maryland-Washington Regional District: (2) the acquisition, development, operation and maintenance or a public park system; (3) in Prince George's County only, the operation of the County public recreation program.

Maryland Department of Transportation (MDOT): State agency responsible for planning and implementing the improvements to those elements of the transportation system that are the administrative responsibility of the state.

Maryland State Highway Administration (SHA): State agency (part of DOT) responsible for the construction and maintenance of the state highway system.

Measures of Effectiveness (MOE): Criteria indicating a level of performance or result which are used to compare the differences between alternatives, scenarios or options.

Metropolitan Washington Council of Governments (MWCOG, COG): The organization of the Washington area's major local governments and their governing officials. COG works toward solutions to such regional problems as growth, transportation, housing, air pollution, water supply, water quality, economic development and noise, and serves as the regional planning organization for Metropolitan Washington.

Metrorail: The Washington Metropolitan Area Transit Authority's rapid rail transit system, composed of the Red, Orange, Yellow, Green, and Blue lines.

MIS (Major Transportation Investment Study): A study of the multi-modal alternatives and impacts of any major change in a transportation system as required under federal regulations. The recent TEA-21 legislation has changed the MIS, requiring more integration with the DEIS process.

Mobility: Measures how well the transportation alternative reduces congestion, increases capacity, and allows for the movement of persons and vehicles. Key mobility measures include vehicle (or person) miles of travel, vehicle (or person) hours of travel, average congested travel speeds and times, and a comparison of vehicle demand with assumed capacity of the roadway facility.

Modal Split: A step in transportation demand modeling where the probability of using a particular mode is calculated. The percent of trips making use of the various methods of transport, including transit, auto driver, auto passenger, walk, bike, or other. (Same as Mode Choice)

Mode (Transportation Mode): A means of traveling such as transit, auto or walk Each mode offers a unique set of service characteristics in terms of travel time, frequency, comfort, reliability, convenience and safety.

Mode Choice: See Modal Split.

Mode Share: The portion of total trips between a set of origins and destinations using a particular travel mode (e.g. transit).

Monorail: Elevated, single rail transit system usually with intermediate distance and passenger capacities.

Montgomery County Council (MCC): The elected legislative body of the County that has the final authority, sitting as the (Regional) District Council on all matters pertaining to planning and zoning. There are nine members elected to four-year terms.

Montgomery County Planning Board (MCPB): The five-member body appointed by the County Council to advise it on all matters pertaining to planning and zoning, and charged with administering the subdivision regulations. (See Maryland-National Capital Park and Planning Commission.)

Multi-modal: Dealing with more than one mode of transportation (e.g., single-occupant auto, bus, rail transit, and walking/bicycling) or the connections between these modes. Often used interchangeably with inter-modal.

MPO (Metropolitan Planning Organization): An official body which is designated for the region to prepare plans and programs that the federal government must approve in order for federal transportation funds to flow to the region. (See TPB and COG.)

Network: One or more alignments evaluated or analyzed together; in general, a set of transportation facilities.

Network Data: Information that are input to a transportation model describing the highway network as a series of numbered links characterized by capacity, speed, length, and location.

Nodes: End points of a link in a transportation network. Nodes are used to represent intersections in the travel model. (See Links.)

Park-and-Ride Lots: Parking lots which allow all-day commuter parking to enable the auto driver to connect with carpools or transit.

Peak Hour Trips: Trips made in any transportation mode during the busiest times of the day, normally in the morning from 7:30 to 8:30 am and during the evening from 4:30 to 5:30 p.m.

Queue Jumper: A right-of-way addition that allows certain vehicles (e.g., HOVs, or buses exclusively) to bypass a traffic bottleneck (such as a traffic signal or entrance ramp line) or toll. Examples include a system on the Bay Bridge in San Francisco that allows HOVs to bypass both the toll and the lines that form at the tollbooths.

Rideshare: A carpool or vanpool arrangement.

Route assignment: The last step in transportation demand models where specific paths for vehicle or transit trips on the network between its origin zone and destination zone is determined.

SHA (State Highway Administration): See Maryland State Highway Administration.

SOV: Single-occupant vehicle; an automobile with only the driver as an occupant.

SOV Accessibility: Opportunities (jobs and homes) available by auto, not counting HOVs.

Special Protection Areas: a watershed or part of a watershed where(1) existing resources , or other environmental features directly relating to those water resources, are of high quality or unusually sensitive: and (2) proposed land uses would threaten the quality or preservation of those resources or features in the absence of special water quality protection measures which are closely coordinated with appropriate land use controls. Designation of an SPA is done by the County Council.

TEA-21: Transportation Equity Act for the 21st Century. The current Federal Transportation Act which succeeded ISTEA.

Through-route: Elimination of a transfer between two transit lines. Equivalent to identical technologies being used on both lines.

TPB (Transportation Planning Board): The designated MPO for the region which consists of representatives of local governments and agencies and which coordinates capital programming and long range planning. TPB is staffed by COG. (See COG and MPO).

Traffic Analysis Zone: There are 296 geographically distinct areas in Montgomery County within the TRAVEL/2 model to detail the origins and destinations of trips. Such zones do not cross freeways such as the Capital Beltway or I-270 and generally contain within them homogenous socioeconomic groups.

Transit Accessibility: A measure indicating the number of opportunities (jobs and houses) that can be reached by transit. (See also Accessibility.)

Transportation Solutions Group: a committee of national and local experts appointed by the Governor to address transportation challenges in Montgomery and Prince George's Counties, Maryland.

Transit Serviceable: Locations of sufficient population, employment, and/or commercial density with adequate provision for pedestrian and bicycle access, organized in a manner that enables them to be served efficiently by public transit.

Transitway: Right-of-way designated for exclusive use by transit, including heavy or light rail vehicles and buses.

Trip Assignment: After trip generation, trip distribution and determination of mode shares (modal split) in the travel modeling process, the vehicle trips produced between zones are placed on roads in the modeling network. Trips are assigned to follow minimum time paths between zones, but these paths may change as roads in the network become congested, slowing traffic down.

Trip Distribution: The allocation of trips from a location among all the possible attracting those trips. The total trips arriving at or leaving a location (zone) after the distribution process must be as close as possible to the trips attracted to or produced by that zone in the trip generation process. (Also known as Destination Choice).

Trip Generation: The number of one-way trips coming from or attracted to a location as a result of land use activity at the location.

VHT (Vehicle Hours Traveled): The total time traveled by all vehicles on the highway network. For a given segment of the network, VHT is the number of vehicles multiplied by the travel times for the link.

VMT (Vehicle Miles Traveled): One vehicle traveling the distance of one mile. Total vehicle miles, thus, is the total mileage traveled by all vehicles.

Washington Metropolitan Area Transit Authority (WMATA): The regional agency responsible for constructing and operating the Metrorail rapid-rail system and operating Metrobus service in the Washington area.

Zone Data: Information input into a transportation model that describes the character of a given area by number of households, or amount of employment. This data is supplemented by parking costs, land area, access and egress times, and other relevant information.

Appendix B
Bus and Rail Transit – A Comparison

1. Summary

Light Rail Transit (LRT), electrically-powered vehicles operating on rails, and busways or Bus Rapid Transit (BRT), standard buses operating on special or restricted roadways, have been considered for application in Montgomery County. Each type of transit has both advantages and disadvantages in specific applications. In this Appendix the differences between the modes are discussed; mode choice, capacities, urban development effects, capital costs and operating costs are considered. The finding is that, given the importance in Montgomery County of using transit investment to support focused development, LRT is preferred for the alignments being considered.

2. Introduction

One of the major issues evaluated in this Report is whether busways (bus rapid transit) or light rail transitways are most appropriate for the alignments under consideration. There are differences in the effects – both positive and negative – each mode has on the adjacent land uses and on the character of the development encouraged by the increased accessibility and the increased number of people walking and driving in the vicinity of the stations.

The cost effectiveness of each mode in a specific application relates to the anticipated number of riders. This is affected by frequency of service, average speed and other factors.

There are also differences in the operating characteristics of the two modes. These differences include the carrying capacity, operating speed, average speed, allowable grades, preferential treatment at traffic signals, route flexibility, and the need for a yard and shop.

The recommendation or a transitway mode relies on the evaluation of several different factors. The factors under consideration address basic operational, technical and system characteristics in categories of land use, flexibility, staging potential, marketing, patronage, and costs. **Table B-1** compares these typical characteristics of Light Rail and Busway transit modes and provides a basis for comparison. Data in the table was prepared by the Maryland Mass Transit Administration using industry references. Not reflected in this table are conditions such as policies, financing, planning and regulation and system design., each of which can affect the factors in a mode selection analysis.

3. Historical Considerations

Since the 1820s when cities first grew large enough that regular transportation of people within cities was necessary, there have been two basic modes of passenger transportation – an omnibus and the train. The omnibus, later motorbus and today simply bus, was a driver-operated single unit vehicle operating on public streets. Originally horse-drawn, the omnibus converted to internal combustion engine technology early in the 20th century. The bus or omnibus is not restricted to a specially constructed right-of-way.

Trains, on the other hand, operated on tracks. While tracks could be, and often were, located in public streets, trains could operate only when there were tracks. The earliest efforts to improve the efficiency of transit services involved construction of elevated tracks on which trains could operate. The elevated line provided separation from other traffic but also provided for dispersion of the noxious emissions from coal-fired train engines. Extensive transit operations in subways were not possible prior to the development of the electric traction motor in the 1880s.

The need to deal with emissions is the major reason that electrically powered rail technologies have been used to serve high density urban centers. Where subway operation is required to achieve a separated right-of-way, electrically powered rail transit technologies have prevailed. There are exceptions. Paris, Montreal and Mexico City have electrically powered subways that use vehicles with rubber-tires. These are essentially rubber-tired trains. Seattle has a subway in which trolley-buses - buses electrically powered by dual overhead wires, operate. Seattle's dual-power buses operate with diesel engines when outside of the tunnel.

When operation in confined spaces such as an underground subway is not required, either rail or bus technologies may be used to provide fast and reliable transit service. The express high-speed transit modes most commonly considered today include:

- Heavy rail transit
- Light rail transit
- Busways

Heavy rail transit is akin to WMATA's Metrorail. It is usually, but not always, electrically powered through a third-rail and, therefore, must be fully separated from all other traffic. Heavy rail typically involves operation of multiple car trains.

Light rail transit (LRT) and busway or bus rapid transit (BRT) involve the use of vehicles that can, when it is advantageous, operate without full separation from other traffic. Both LRT and BRT may cross public roads at grade or operate on public roadways. The "light" in light-rail does not mean that the vehicles or track used are necessarily of lesser weight than a heavy rail system. Rather, it relates to the fact that the related infrastructure - rights-of-way, stations, separation - are typically less extensive than for "heavy rail."

4. Land Use Effects

A high quality transit service, when combined with other public policy actions, can be a stimulus to development or redevelopment that supports and engenders greater transit use. The effects of the Metrorail system in Bethesda and along the Orange Line in Arlington County illustrate what can be achieved. The lack of comparable development at other Metrorail stations illustrates that transit, in and of itself, is not sufficient.

The flexibility that is the greatest service asset of bus operations is its greatest detriment to promoting desired land use patterns. The significant public investment embodied in a Light Rail System represents a commitment to maintaining a high level of transit service over an extended

period. This type of public sector commitment gives private sector investors the confidence to proceed with development.

Several studies have been conducted which indicate that increased transportation accessibility from permanent facilities increases real estate values. These facilities include rail transit, both heavy rail and light rail. No studies were found that indicated that busways or frequent bus service provided any increase in value or supported the development of mixed-use centers of activity.

Although heavy rail transit provides more accessibility at each station than light rail and, therefore, a stronger support for economic development, light rail is also seen as having a positive effect on land values and on development and redevelopment in response to the accessibility it provides. Light rail tends to have more frequent stations and to carry a lower volume of passengers, therefore, the character of the mixed-use centers is more of a community/neighborhood scale than an urban scale.

Almost every area which has invested in Light Rail Transit has decided to expand the initial service: Baltimore, Cleveland, Los Angeles, Portland, Sacramento, San Diego, San Francisco, San Jose, and others.

Development around busway stations, similar to the types of development seen around rail stations, has not yet been observed in U.S. applications.

5. Mode Choice Factors

The process used by travelers when deciding whether to use transit or a private vehicle for a given trip is quite complex. The choice involves many factors, some of which relate to the traveler (e.g. the availability of a personal vehicle), some which relate to the trip destination (e.g. the availability and cost of parking) and some of which relate to the quality of the trip (e.g. the length of walk required at each end of the trip, the wait required for a transit vehicle, the duration of the ride on a transit vehicle).

While public investments and policies can have some effect on traveler attributes and features of the trip origin and destination areas, the aspect of the trip choice most directly affected by public action relates to the quality of transit service. Both academic studies and personal experience confirm that travelers, especially travelers who have a choice of mode, are more likely to choose transit when:

- travel time on the transit vehicle is fast, comparable to or better than travel by car, and subject to little variation.
- the wait for a vehicle is short and subject to little variation
- travelers can walk to the boarding location at both ends of the trip

Even a hundred years ago, it was apparent that transit vehicles operating on streets in mixed traffic with private vehicles could not be operated at speeds that permitted efficient and attractive service. The subways of Boston and New York were built to separate transit services from other traffic. This need remains true today – transit cannot offer a competitive, fast and reliable service if it is mixed

with other traffic and faces the same congestion. Effective, high-speed, high-capacity transit services must have their own, protected right-of-way.

6. Differences Between Busways and Light Rail

- **Light Rail Transit**

LRT services typically involve trains of two or more cars operating along a set route stopping at on-line stations. Car capacity depends on vehicle design. A typical LRT car will have between 50 and 70 seats and a total capacity, with standees of between 100 and 200.

Light Rail Transit can be operated in many different ways. Tracks and electric power can be provided on a separated right-of-way reserved for LRT at grade, above ground or in subway. The needed facilities can also be provided in mixed traffic on city streets or even on pedestrian malls. The use of overhead power and cars with a shorter wheelbase than is common for heavy rail transit, makes it possible to fit LRT into many types of urban environments.

In the past three decades, new Light Rail Transit services have been initiated in Baltimore, Buffalo, Dallas, Denver, Los Angeles, Portland, Sacramento, St. Louis, San Diego and San Jose. Existing rail services in Boston, Cleveland and Pittsburgh have been upgraded. Studies for new LRT operations are underway in over one hundred locations in the United States.

Stations

Stations for LRT operations can range from quite complex (e.g. the underground downtown terminal station on the Los Angeles Blue Line) to a simple platform at the edge of the street or track (e.g. Sacramento or Portland).

Stations are typically "low-platform." Most light-rail cars have stairs on the vehicles, so that stations must include a high-platform area for wheelchair loading and unloading. Low-floor light-rail cars are now being manufactured obviating the need for special platforms.

Routing Patterns

A typical light-rail service involves one route operating between two terminal stations, one at each end of the route, on regular frequency. In some operations (e.g. Boston, Cleveland, Philadelphia, Pittsburgh, San Diego, San Francisco), several routes branch from a common trunk, providing a higher frequency service in areas of greater demand.

The operations in Boston, Los Angeles, Pittsburgh, Philadelphia, St. Louis and San Francisco involve on-street or an at-grade right-of-way operation in residential areas with subway operation in the higher density downtown districts. Other systems have other

variations. Baltimore, Portland, Dallas and Denver operate mostly or entirely at-grade with downtown operation on-street or on a transit mall. Buffalo operates in subway outside of downtown but at-grade on a transit mall in downtown.

Service Frequencies

LRT can be operated either with signals (wayside or in-cab) or with full manual control. Signals are preferred for higher speed or subway operations. Minimum service frequencies can range from almost no separation, as with manual operation in Philadelphia, to sixty to ninety seconds with signals. Typical frequencies are ten to fifteen minutes between trains.

- **Bus Rapid Transit**

Flexibility in operating patterns is a key feature of bus operations. Since each unit (bus) is operated by a separate driver and since the vehicles can operate not only on specially provided rights-of-way but also on any roadway, services may be tailored to specific needs of the environment in which they operate. As a result, there are many variations in BRT or busway operating patterns.

Services having features that could be characterized as Bus Rapid Transit operate in Houston, Los Angeles, Miami, Ottawa, Northern New Jersey, Northern Virginia, Pittsburgh, and Seattle.

Stations

A primary difference among the several bus rapid transit operations is the presence or absence of stations.

No Stations – The Northern New Jersey service (Lincoln Tunnel approach) and Northern Virginia service (Shirley Highway) have no intermediate stations. Buses circulate in communities, enter the bus priority roadway and travel to the end of the facility without stops or stations.

Off-Line Stations – In Houston, buses operate in HOV lanes located in freeway medians. Stations are located adjacent to the freeway. Buses stopping at a station must exit the HOV lanes using special interchanges designed for bus-only operation.

On-Line Stations – The Los Angeles (El Monte busway), Ottawa, Pittsburgh and Seattle operations have on-line stations. Buses traveling the roadway need only to stop at specially built stations to board or discharge passengers. Not all bus routes on the facility need stop at all stations.

Routing Patterns

The flexibility offered by bus operations lead to many varied routing patterns. The basic pattern, used primarily where there are no intermediate stations, involves circulation through a neighborhood to collect passengers followed by entrance to the bus facility with direct, express service to a destination area such as a downtown or a suburban activity center.

Routes serving the destination may end at a bus terminal (e.g. Port Authority Bus Terminal, Pentagon Metrorail Station) or they may circulate through the downtown (e.g. Houston, Ottawa, Pittsburgh, Los Angeles) on surface streets. Exclusive bus lanes on the surface streets may be used to keep bus operations free of local congestion. In Seattle, the dual powered buses operate on electric power through a specially built bus tunnel.

Ottawa has routes that operate much like a rail line, in that they use only exclusive bus elements of the network and operate between terminal stations making stops at intermediate stations.

Service Frequencies

The frequency of service available for any given trip over a busway system depends on the operating strategy adopted by the transit agency. The frequency depends, in part, on the number of routes serving any station pair. For example, if five neighborhood routes, each with a 20 minute peak hour frequency, enter a busway at a common location and proceed to the downtown, there will be 15 buses in the peak hour resulting in a four minute headway. If these routes all operate express, however, there would be no service to intermediate locations. To avoid this, a shuttle route stopping at all stations would be operated along the busway. In Ottawa, this route operates every five minutes throughout the day.

7. LRT and BRT Capacity

A rail train consisting of four cars with a capacity of 150 passengers per car services 600 persons. At a five minute headway, the 12 trains per hour could carry 7,200 persons in the peak direction past the peak load point. This would include both seated passengers and standees.

Since express bus operations generally strive for a seated load, a bus service would require about 160 regular buses or 120 articulated buses to serve the same number of passengers. This is equivalent to a bus every 20 to 30 seconds.

8. Comparative Costs

The costs of developing and operating either an LRT or BRT system depend on so many unique local factors that it is difficult to make precise comparisons. In general:

- Bus capital costs will be less than rail capital costs
- Bus operating costs, at high volumes, about 3,000 or more passengers per hour in the peak direction, will be greater than rail operating costs

- **Capital Costs**

  Right-of-Way – the width of right-of-way required is about the same for either mode. Bus may require slightly greater width.

  Guideway – The bus guideway is essentially a two-lane roadway. The rail guideway requires general preparation similar to a roadway, but uses rails on ties rather than final pavement. In general, rail guideway costs are higher since there is less standardization.

  Note that a bus guideway can be shared with other vehicles (e.g. Shirley Highway, Houston, El Monte, parts of the Ottawa system). This does not reduce the total cost of the facility but may reduce the share of the cost that must be borne by transit funding sources.

  Power Supply – Rail or electrically powered bus systems will require overhead power lines and wayside substations. Other bus operations will not require separate power systems.

  Command and Control – Rail systems will typically have either "in vehicle" or wayside signals. Bus services typically do not use signal systems although standard traffic signals may be used to control bus operations at entry or exit locations.

  Stations – Stations for either BRT or LRT can be quite simple or quite complex. Costs are equivalent.

- **Operating Costs**

  The unit costs of operating a rail car are typically greater than the unit costs of operating a bus, when all costs are taken into account – driver wages; power supply; maintenance of vehicles, way and structures; etc. In one system, the cost of operating a single rail car at 30 mph was 60% greater than the cost of operating a single bus.

  However, the capacity of a rail car is at least twice that of a bus. Where there is sufficient demand, the cost per passenger carried, and hence total operating cost, will be less for rail than or bus.

9. Effective Operating Environments

The nature of bus services, single unit vehicles that can operate on any roadway, makes bus an efficient mode when it is necessary to collect riders from widely dispersed origins or to deliver riders to dispersed destinations. High speed line-haul operation can be achieved by bypassing intermediate stops, but this reduces the level-of-service. Buses can best penetrate activity centers when street capacity is sufficient to permit the provision of dedicated, exclusive bus lanes.

Rail services are most efficient when serving high volumes of riders. This, coupled with the ability of electrically powered vehicles to operate underground when necessary, makes rail the mode of choice for serving higher density, concentrated activity centers. The higher capacity of a rail train, compared to a single bus, means that rail stopping at a series of stations can be more effective than multiple bus routes when serving a series of activity nodes along a linear corridor.

Table B-1: Typical Characteristics of Light Rail and Busway

CHARACTERISTICS	LIGHT RAIL	BUSWAY
Operations		
Transit Unit Capacity (LR= 1 - 4 veh/transit unit; Busway= 1 veh/TU)	84 – 336 seated 174 – 696 seated/standing	43 seated (64 articulated) 66 standing (96 articulated)
Operating Environment	Mixed with vehicular traffic but on separate passageway or in exclusive R/W	Median Lane of mixed traffic or Exclusive Roadway
Average Operating Speed	In traffic = 15 - 30 mph Excl. R/W = 35 - 60 mph	In traffic = 10 - 25 mph Excl. R/W = 25 - 55 mph
Typical Station Spacing	1/4 mile to 1 mile	
Land Use	• "Theoretically", has stronger potential to induce adjacent development • LRT stations perceived as more desirable for commercial development	• Stations can closely resemble those of a typical LRT system. • Lesser densities of land use and population dispersal trends may be better supported by busway service to meet ridership thresholds and cost-effectiveness.
Flexibility	Can operate in-street or exclusive r/w	
	• Requires additional rail r/w at stations for express service "skip stop" mode	• Can maneuver tighter curves • Routes are easily changeable to meet travel patterns • Buses can operate as a feeder service to rail transit and/or a distribution service to the street system • Promotes express service better by allowing a vehicle to bypass a bus at a station as long as there is no bus approaching from the opposite direction.
Staging Potential	• Sufficient length must be initially constructed • System can be developed incrementally	• System can be developed incrementally • Buses can share some existing roadway corridors, minimizing r/w costs
Marketing/Passenger Attraction	Function of system performance and accessibility	
	"Perceived" as having a higher public orientation	
Capital Costs	Capital costs for a busway are generally thought to be less than those for LRT, however the actual costs of each individual system depend to a large degree on the local conditions and context in which the system will be operated. Factors key to determining capital costs include those that influence the physical layout of the system: • Operating environment – at-grade, on an aerial guideway or in a tunnel and single or double guideway • The number and type of stations – cost-effective or elaborate, etc. Capital costs of some recent LRT and Busway systems in the U.S. which are in various phases of development are:	
	LRT: $19 M - $103 M	Busway: $9.3 M - $58.4 M per mile

Source: Maryland Mass Transit Administration

Appendix C
The TRAVEL/2 Transportation Model

This appendix briefly explains the TRAVEL/2 transportation model and the assumptions and modeling methodology used in this analysis. For a more detailed explanation, see "TRAVEL/2: A Simultaneous Approach to Transportation Modeling," available at the Transportation Division of the Montgomery County Park and Planning Department.

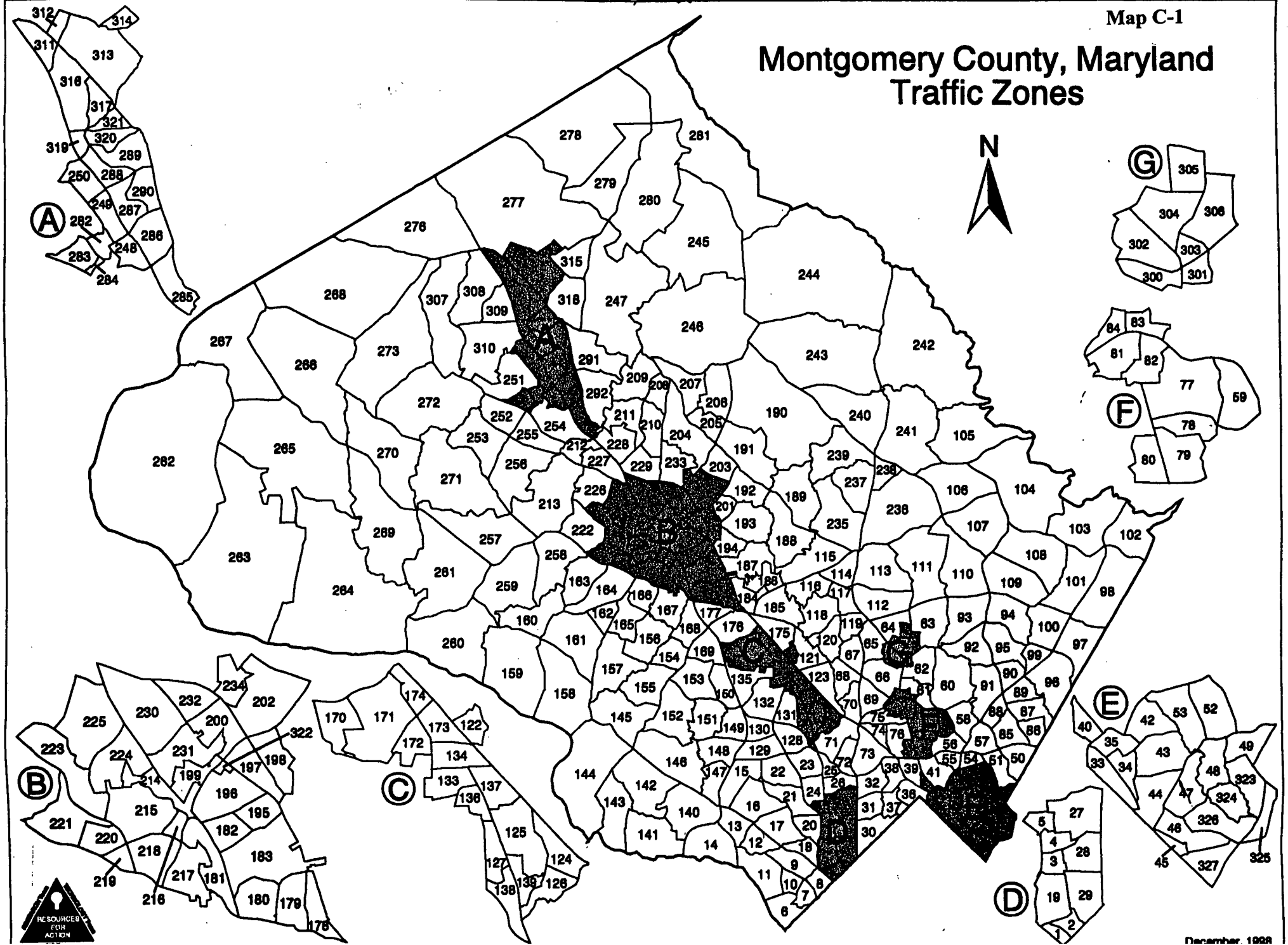
The TRAVEL/2 regional transportation model is designed to forecast travel demand, given a set of inputs detailing the land use patterns, demographic information, and transportation network. Generally, a transportation model attempts to answer several questions that are of importance to planners and policy makers:

- How many people are traveling?
- Where are they going?
- What type of transportation are they using?
- What time of day do they make their trips?
- What route do they take?
- How much time does it take them to reach their destination?

TRAVEL/2 does not answer these questions by simulating the decisions of each individual making a trip. Transportation models generally assign regional land use activity (jobs, households, and other demographic data) to traffic zones. Since TRAVEL/2 is an aggregate model, the "people" in the model do not travel from building to building, they travel between traffic zones. Two general characteristics can be applied when defining a traffic zone: it should not cross a major highway and it should have relatively homogenous land uses. Ideally, each traffic zone should also have roughly the same number of trips associated with it; thus, the more urban an area is, the smaller its traffic zones are. For instance, the Silver Spring CBD (area: 0.59 square miles) has three traffic zones, while the Damascus policy area (area: 9.60 square miles) has only two. There are 318 traffic zones within Montgomery County, as seen in **Map C-1**; 677 zones constitute TRAVEL/2's modeling region, shown on **Map C-2**.

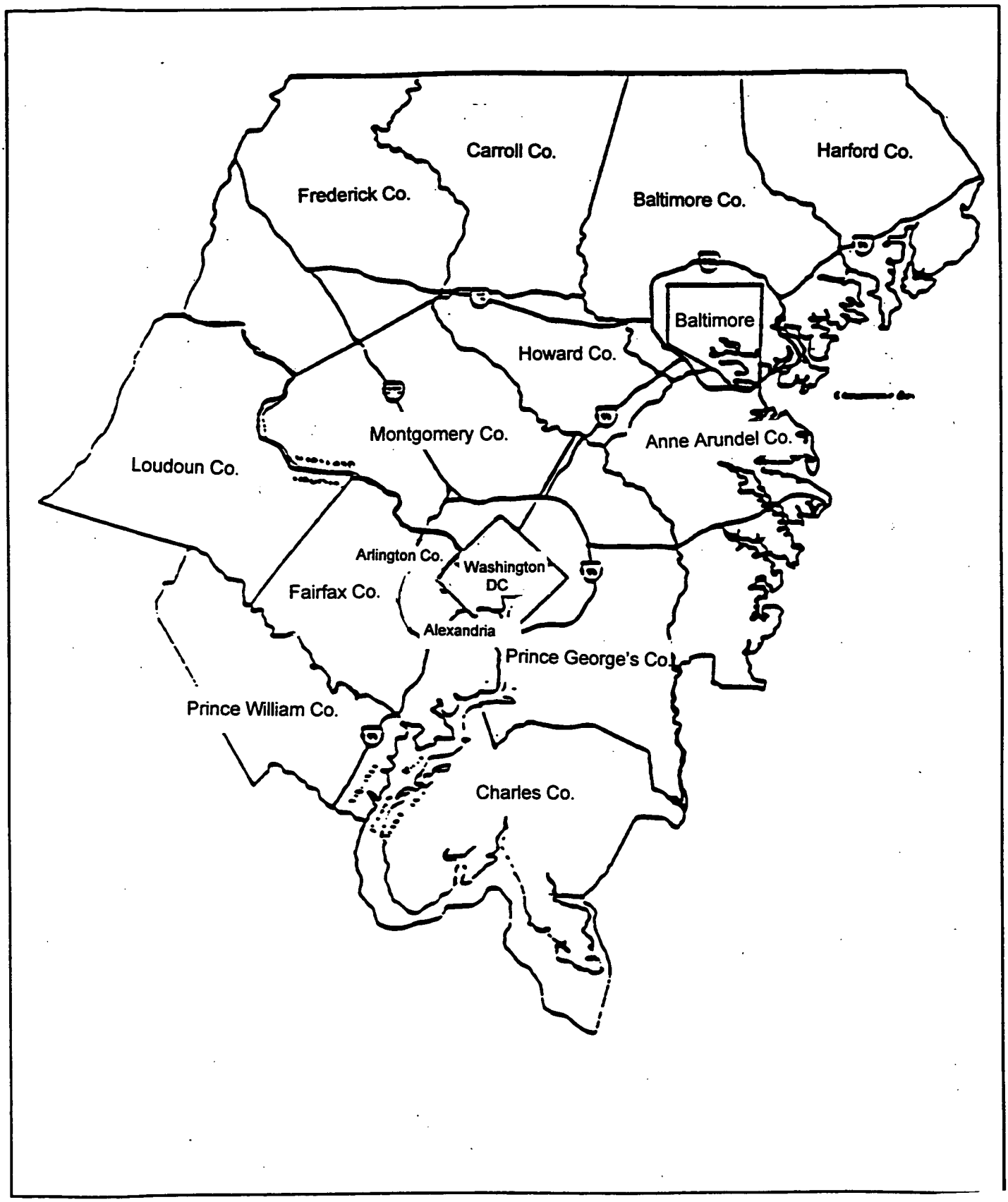
Map C-1

Montgomery County, Maryland
Traffic Zones



December, 1998

Map C-2 TRAVEL/2 Modeling Region



1. Input Assumptions

The TRAVEL/2 model requires that input assumptions be made for a number of factors that influence mode choice as well as other aspects of travel behavior. Input assumptions include:

- **Land Use**

  The "base case" application of the TRAVEL/2 model for the Transportation Policy Report used the Round 6A MWCOG forecasts and Round 5A Baltimore Metropolitan Council (BMC) forecasts for Employment, population, and household, distribution for 2020. These forecasts, developed for MWCOG by staff in the Planning Department's Research and Technology Center Division, as well as by planning departments around the Washington-Baltimore region, provide population, household and employment information for Montgomery County and for the other jurisdictions within MWCOG's and BMC's boundaries. These land use data were then assigned to the County's 677 traffic zones in the model region.

  In addition to the "base case" land use forecast described above, the alternative networks of the Transportation Policy Report were evaluated in reference to a Master Plan Build-out Scenario and Year 2050 scenarios.

  In conducting analyses on alternative transitway and HOV alignments, year 2020 land use assumptions remained consistent so each alignment (or combination of alignments) could be measured for its contribution to the overall mobility for an area with consistent land use patterns.

- **Networks**

  The roadways, transitways, bike paths, and sidewalks in an area are represented by a computer network. The network comprises links representing portions of streets that are joined at nodes in spiderweb fashion, with the nodes representing intersections. All traffic in a zone comes from and goes to one single point in the zone. This point is known as a centroid because it is located as closely as possible to the traffic zone's geographic center. Since all traffic in a zone comes from the centroid, the model does not account for trips which stay within a zone. Fortunately, such trips make up only a small fraction of those taken. Centroids are joined to the network by one or more connectors. Since not all streets are represented in the network, the trips from a given zone move between the centroid and the network by one of these connectors. Representation of traffic flow is better on major roads, where the cumulative effect of many zones is at work, than it is on local streets.

  Individual network links are coded with information defining the length, number of lanes, vehicular capacity and freeflow speed determined by the roadway type. As discussed further below, the actual speed on a link decreases as the congestion on it increases.

With the input of the Technical Work Group (TWG), a background transit network was prepared for bus, Metrorail, MARC commuter rail service, and the three master-planned transitways. In most cases, bus routes share links with automobiles and other motorized vehicles on the roadway network.

Separate links were also coded to represent facilities carrying high-occupancy vehicles only. They are similar to links representing regular roads, but allow only buses and multi-passenger (HOV) vehicles. In this work, vehicles with two or more occupants qualified as HOVs. They were permitted to travel anywhere on the highway network as well as on the HOV links, but single-occupant vehicles were limited to non-HOV (or general purpose) roadway links.

- **Travel Characteristics**

Data sets from the Metropolitan Washington Council of Governments (COG) Household Travel Survey, Montgomery County Park and Planning Department (MCPPD) Trip Generation Studies, the MCPD Census Update, the MCPD Travel Time and Delay Study, Metrorail Passenger Studies, and MCPPD Traffic Counts databases were used to estimate, calibrate, and validate the model. Based on observed group travel behavior, population and employment data, and other socioeconomic data, the TRAVEL/2 computer model can estimate the aggregate travel behavior of the entire regional population.

2. Model Components

The structure of the TRAVEL/2 transportation model is graphically presented in **Figure C-1.** As seen, there are several aspects considered in estimating transportation demand. Each aspect can be thought of as answering one of seven questions:

TRAVEL/2 Model Components

Trip generation: How many people are traveling and for what purpose?

Destination choice: Where are they going?

Departure time choice: What time do they make the trip?

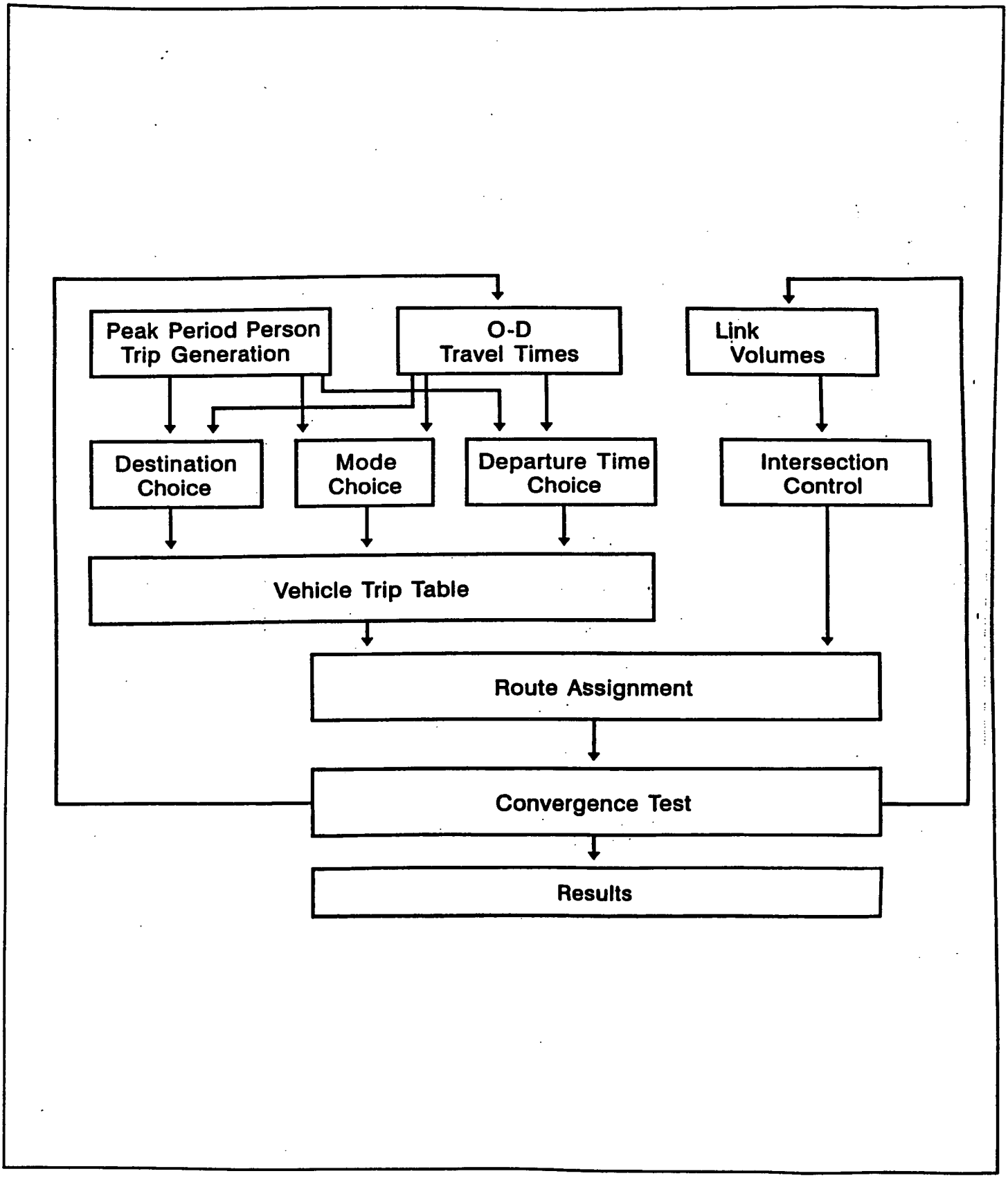
Mode choice: What type of transportation are they choosing?

Route assignment: Which route do they take?

Intersection control: How does delay at intersections differ from delay on roadways?

Feedback: How does congestion, or increased travel time, influence destination choice, departure choice, and route choice?

Figure C-1 - Transportation Modeling Process (flowchart)



- **Trip Generation**

  The first step in the modeling process, trip generation, relates land use and demographic data to the creation of person trips. In residential zones, the crucial factors are the number of households, dwelling type (single- or multi-family), number of persons per household, and age of each person. Surveys in Montgomery County have determined that these are the main variables that account for the number of home-based trips. Employment zones are separated into office, retail, industrial, and "other" uses, and the crucial variable is the number of employees. A trip is a one-way movement of a person from an origin to a destination.

- **Destination Choice**

  Destination choice, or trip distribution, spreads the number of person trips coming from each traffic zone among all possible destination zones. TRAVEL/2 uses a "gravity" model that distributes the trips between two zones based on three characteristics:

  - Time: the greater the travel time between two zones, the fewer trips distributed between them

  - Opportunities: the greater the housing and employment opportunities in two zones, the more trips distributed between them

  - Competition: the greater the number of people who share the same origin, the less likely those individuals can share the same destination.

The destination choice aspect of the TRAVEL/2 model is more sophisticated than most because, as discussed below, it re-calculates — or feeds back — the destination choice with congested travel times as input. This means that destination choice is influenced by congestion. The feedback process may go through several iterations.

- **Departure Time**

  Person trip volumes are calculated by the trip generation process for a three-hour afternoon peak period, but the auto assignment that completes the modeling is for the afternoon peak hour. Departure time, a special feature of the TRAVEL/2 model, uses travel survey data to determine the fraction of afternoon trips that will occur during the 4:30-5:30 peak hour. As the network becomes more congested, some trips may begin earlier or later to avoid peak hour congestion.

- **Mode Choice**

  Mode choice calculates the probability of using a particular mode of transportation. In the TRAVEL/2 model, mode choice is carried out in parallel with the distribution and departure time calculations. It essentially compares both the travel time and out-of-pocket cost of a certain trip for seven separate modes:

  1) walking to transit
  2) driving to transit (park and ride)
  3) receiving a ride to transit (kiss and ride)
  4) driving alone
  5) traveling in a two-person carpool
  6) traveling in a carpool with three or more persons
  7) walking or bicycling.

  A probability is then assigned for using each of the modes for all trips between two particular traffic zones. This probability takes into account the density of housing where the person lives, auto ownership, sidewalk availability, and, for rail transit, the percent of households and jobs in the zone that are within walking distance of a station.

- **Route Assignment**

  In transportation demand models, the last step is usually route assignment, where a specific path for each vehicle or transit trip on the network between its origin zone and destination zone is determined. The first iteration simply places each trip on an optimal network path — that path with the shortest travel time — based on freeflow link speeds; congestion is not yet a factor in travel time. After the first iteration, the delay is calculated resulting from the roadway capacity and intersection restraints. As a result of the delay, a fraction of the total trips may move to different paths. The delay is then recalculated for the third iteration. In this model, this iterative assignment process seeks an equilibrium, or a state in which all paths used between an origin-destination pair have roughly equal travel times.

  For trips that involve transit use, total travel time includes walking or driving to the transit stop or station, boarding, transferring, etc. The model finds the optimal travel time for all transit users, based on shortest network paths.

- **Intersection Delay**

  An innovative feature of the TRAVEL/2 model is its calculation of intersection delay as traffic is put on the network. This delay is then included in the travel time calculations, influencing demand on the network. Intersection delay is an important element in modeling travel demand since links with intersection control have higher travel times.

- **Feedback**

  Feedback is the engine of the TRAVEL/2 computer model, and its use of feedback is one of the most rigorous in the country. TRAVEL/2 uses an iterative procedure to estimate travel demand, the impact of the demand on travel time, and the changes in travel demand that result from changed travel times due to congestion. This enables an estimate of demand to influence travel time and vice versa, meaning that the travel time between two points is not fixed in advance and varies depending on the level of congestion on the transportation network being tested.

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TRANSPORTATION POLICY REPORT

THE MARYLAND-NATIONAL CAPITAL PARK & PLANNING COMMISSION
MONTGOMERY COUNTY PARK & PLANNING DEPARTMENT